**Report on current business processes and dissemination systems in MONSTAT**



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## Document history

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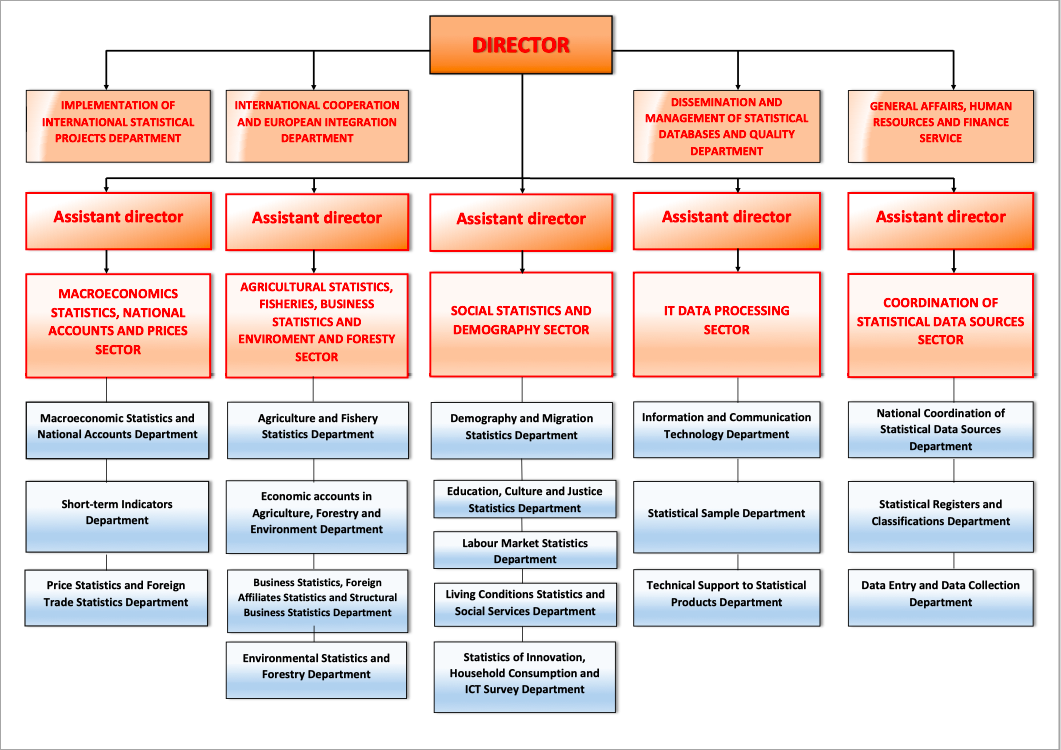
1. Introduction
   1. Purpose of the document

This document represents a report with recommendations for improvements of existing dissemination database, including technical specifications for fully developed dissemination system and terms of reference for a future dissemination system in MONSTAT (the national statistical office of Montenegro), in consultation with UNECE and the UN Country Team in Montenegro.

* 1. About MONSTAT

Statistical Office of Montenegro - MONSTAT is competent body for the production of official statistics. As the statistical leader, MONSTAT is obliged to collect data, processes and disseminate statistics performed in independent, professional, transparent and highly expert manner.

The organizational structure of MONSTAT is shown in the figure below. As we can see, there are 12 organizational units for different types of statistics, which cover about 150 statistical surveys (e.g. the annual plan for 2020 included 168 statistical activities). Publishing periodicity can be: annual, biannual, quarterly, montly. There are also 6 other units (see picture below) involved in data processing and quality. They all communicate with each other, share data, and work together to ensure that data is accurate and available to the public in a timely manner. Everyone has their share of responsibility in the process of collecting, processing, controlling, approving and publishing data.



* 1. Proposed technologies

After reviewing the current situation on process of preparing, processing and publishing data for dissemination, we realized that it's not automated:

* data is created separately within the statistical organizational units,
* data is emailed between organizational units without the ability to track data status,
* data is approved by email.

For more than half of the statistical surveys, the data is never placed in a database (the data is only in excel files), except at the end in dissemination database, which is still not used.

Also, we realized that MONSTAT has developed very good designed relation database (dissemination database), whose usability is currently limited, in the absence of an application for data entry and manipulation. Data are managed manually, which requires the involvement of more human resources, to ensure a higher degree of data accuracy.

To automate the overall process, which includes: data collection, processing, preparing for dissemination, administration of dissemination database, surveys data status tracking, approvals, publishing (i.e. quality control improvement) we suggest combination of:

* implementation of user-friendly web application (web application or application in further text),
* introduction and configuration of ETL (Extract, Transform and Load) tool.

For web application development, we recommend technologies that are widely used in the world: Spring and Angular. Spring Boot is an open source Java framework. Along with the Spring Ecosystem, it has become a top pick for many organizations and developers for building enterprise applications with Java. Angular is an HTML framework for dynamic web applications.

Regarding ETL tool, we recommend Microsoft SSIS, as in MONSTAT use Microsoft SQL Server. SQL Server Integration Services (SSIS) is a component of the Microsoft SQL Server database software that can be used to perform a broad range of data migration tasks. It features a data warehousing tool used for data extraction, transformation, and loading (ETL).

In the text below, we are explaining how the proposed should be used.

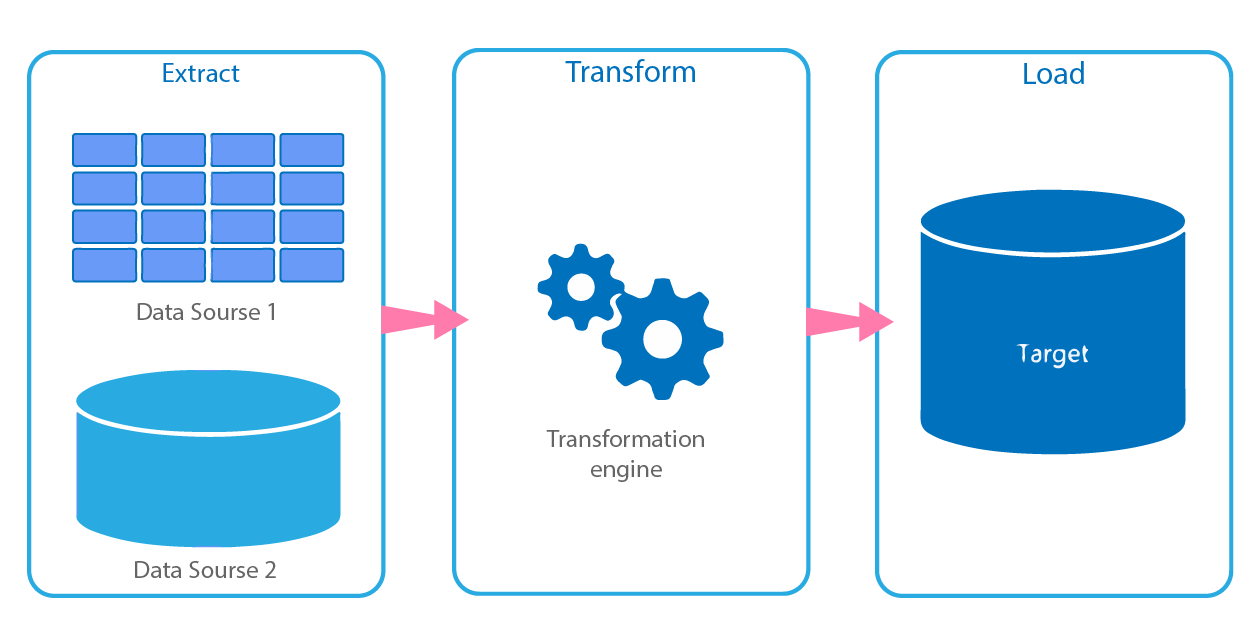
* + 1. About ETL tool

ETL is the abbreviation of Extract, Transform and Load. It extracts the data from different sources and converts it into a understandable format. This data is used for storing in a database and used for future reference.

Extract involves the process of reading the data from multiple sources. There are many storage systems where the data can be stored, some of them are XML files, Flat files, Relational Database management systems (RDBMS), etc.

Transform converts the extracted data from its initial format to the required format. The various methods used for transforming the data are filtering, sorting, conversion, removing the duplicates and translating.

Load is the final step of the ETL process which writes the data into the target database.



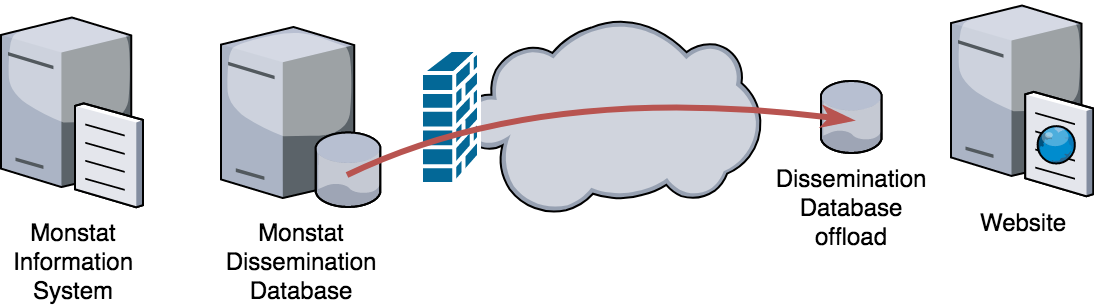
ETL tool is very easy to use as the tool itself identifies data sources and the rules for extracting and data processing. This process eliminates the need of manual programming methods, where you are required to write the code and procedures.

ETL offers strong data integration tools for performing ETL processes. As the data integration is complex and slow process, ETL solves the problem by completing the integration jobs 10x faster than manual programming.

* 1. Infrastructure and Dimensioning

Future Informational System that should be introduced in MONSTAT must follow concepts and definitions provided bellow:

* All components must be redundant (network, power supply, server disks, etc.)
* Security placement zones should be established (Secure zone for Database and Informational system, DMZ for dissemination database, Public zone for Website).
* Hardware capacity should be defined in accordance with 5yrs forecast in relation to Database size, number of ETL processes, number of visitors to dissemination database and website.
* Communication between DMZ and Public zone (MONSTAT Informational System and public Website) should be encrypted using IPSEC VPN tunnel and protected with Firewalls on both sites.



1. Business processes
   1. Data collection
      1. Current process

There are few methods to collect data:

* from paper
  + where the interviewer enters the data from paper into the appropriate excel template,
  + or statistician enters the data from paper into the database through the internally developed .NET application, made specifically for a given statistical survey,
* through an electronic survey - where the data goes directly to the SQL database,
* from administrative source, mainly as Microsoft Access database.

A couple of examples for a better picture:

* Consumer prices index CPI survey: The interviewer goes to the stores and fills in the prices on the paper list of products. Based on the collected material, he fills in the appropriate excel template and send it to the statistician by email.
* Foreign trade survey: Customs Administration sends the data monthly, as an ACCESS database. The data is sent to the IT sector, for data processing to be adjusted for the statistician, and then sent back to the statistician, also as an ACCESS database, to continue the process. All communication takes place via email.
* Agriculture survey: data is collected using the CAPI (Computer-Assisted Personal Interviews) method, the interviewer has a tablet, and collects info through it. There are a CAPI online (directly to SQL database) and CAPI offline method (IT sector transfers data from the interviewer's computer to the SQLdatabase), but in the end all the data ends up in the SQL database.
* Municipal waste survey: all relevant companies, from all municipalities, submit completed paper forms. The statistician enters data from the paper through an internally developed .NET application.
* Economic Accounts for agriculture, forestry and environment survey: in this case, the data source is the set of results from other surveys. The data is requested by an email to colleagues to provide the necessary data and then entered into the Excel template.

Ideally, companies should fill out surveys electronically, and households by a call.

So we have that the initial data is in excel, or SQL database, or Microsoft Access database.

* + 1. Conclusion

The main goal should be to complete each survey directly or in the easiest possible way in the SQL database. Each survey requires adjustment for itself.

* + 1. Proposed solution

1. Input data is imported into the system through a web application, by an interviewer or a person who possesses data sent by other sources, uploading files.
2. By importing data, the application will trigger ETL which will store the data into the SQL database, based on previously set configuration in the background. Also, ETL can perform appropriate data controls, definied and configured for all statistical surveys.
3. ETL will send email notification to the statistician and the person who performed the import of data about the success of the action. Action status is also available through the web application.
   1. Data processing
      1. Current excel sheet process

One of the represented ways of data processing is the following:

1. the statistician receives the data from the interviewers in the appropriate excel format,
2. statistician processes the data and creates other appropriate excel formats (sheets) with the necessary data that the given survey requires at the end and for the public,
3. statistician performs logical-computational control through excel, using information comparison and similar functions that would highlight some illogicalities and indicate potential problems,
4. in some cases, when it is necessary to perform a weighting, the data is sent to the appropriate department, as excel sheet, by email. In the same way data are returned to the statistician. This is where information and the latest versions of documents can be lost,
5. after all the necessary processing and controls, from the final excel, statistician manually makes the excel for the press release to be posted on the website. Excel is emailed to the chief and assistant for approval,
6. also, the statistician manually makes excel for the needs of a website that is currently a replacement of the lack of use of the dissemination database,
7. and finally, the statistician manually enters the data in excel format for the dissemination database, which is not currently used anywhere.
   * 1. Conclusion

As can be seen in the described process, too many things are done manually and copied from one excel sheet to another excel sheet, then sent by email for revision, additional processing, approval etc., and are returned in the same way.

Here we have a great chances for errors and loss of information, which ultimately results in erroneous data placed for the public.

Another big problem is that statisticians fill in a large number of excel sheets manually, copying large amounts of data, which results in inefficient spending of time.

The point of having a system is that the same data is entered only once, in one place, and from there, using tools, are transported further, processed, etc.

After talking to statisticians on the topic of various surveys, it was concluded that each survey requires its own set of rules, data and formulas for processing.

The MONSTAT IT department has already developed a few internal applications for data processing. The process is described below.

* + 1. Current .NET application process

The process takes place as follows:

1. the collected data for particular survey is entered directly into the database via the internally developed .NET application (strictly for given survey),
2. all necessary controls are built into the application,
3. the application allows data changes as needed,
4. if necessary, the application allows the appropriate export of data for weighing (because the weighting department has its own programs and tools for heavy weighting), and also the possibility of importing the delivered excel,
5. the application allows the export of all necessary excel reports for announcements, various institutions that require certain data formats.
   * 1. Conclusion

The main goals, stated below, remain:

* to remove (or minimize) the amount of manual work,
* that each statistical survey has a defined database, with clearly defined fields, which will be the basis for each application for data entry and processing. So we know that the current data is the one that is in the database, and then when excel is needed, there is a procedure by which it is imported into the database. This database will be the source for all data sent out, and also for dissemination database.

But**,** this method is not desirable because each survey requires an application for itself, its maintenance and programming as needed. Also, in this case, the part of the system missing, that would communicate the status of each survey, as well as the person with whom the data is currently being processed or approved.

There are surveys that have the same set of data, that they demand from the same source (client). Here should be paid attention and make a model that the total set of questions goes to the client once, which is entered into the database, and then each statistician uses the data he needs from database, through an application.

There are surveys where input parameters are the results of some other surveys. Currently, the statistician doesn't have access to this data through the database, but writes a letter by email to be delivered as excel sheet. As part of process improvement, this issue should be considered by implementing a model so that statisticians have access to all necessary data from the database.

* + 1. Proposed solution

1. When the statistician has been notified that data are stored in the system, he has the ability to view and search the data through the application. If a survey requires the entry of some additional data, which is variable, and is not configured in the ETL itself, it is possible to enter it through the application, before triggering the processing.
2. If data looks fine, on click through the application, starts further necessary data processing, which will be performed by the ETL in the way previously configured in the background for a given survey.
3. ETL tool will send email notification to the statistician about the success of the action. The status of the action will also be visible through the application.

There are surveys that requires the use of external applications, which are standard in their fields. In that case, the process would go as follows:

1. The application allows the export of data in the appropriate form for each survey, with the display of the status of waiting for the return of processed or updated data.
2. The application allows the import of processed data, by uploading the appropriate file, which will trigger the ETL to place the data in the database, with appropriate control.

The statistician always has an insight into the data, the possibility of searchingand correcting the data through the web application.

1. When the statistician is sure that the data is correct, he sends it to his superior for approval with one click through the application.
2. The superior receives an email notification that the data had been sent for approval for a specific survey.
3. The superior has an overview of the data through the application and the ability to approve or reject the request for approval with an appropriate comment.
4. The application sends to statistician an email notification about the sent response, and the status can be seen through the application itself. Depending on the response, the statistician may publish the data or do what is requested and resubmit for approval, also through the application.
   1. Preparing data for Dissemination Database
      1. Current process

Currently, all data for the dissemination database is created manually, by statisticians, as an excel template. That excel is further imported into the SQL dissemination database, via SQL wizard for import excel files. The data is first imported into temp table, and then, after manual verification and approval, transferred to the production table via SQL scripts.

* + 1. Conclusion

As we have already stated above, data are managed manualy, which requires the involvement of more human resources, to ensure a higher degree of data accuracy. It takes time to maintain it, and we have potential risks of losing data when done manually.

The problem is that none of the employees has access to the dissemination database, except for IT people. The data is in the database and there is no user-interface for viewing and manipulating the data. There is no easy way to access data, approve, publish and everything needed for dissemination database to be used on the website.

* + 1. Proposed solution

1. Once the survey data has been approved, the statistician has the ability to initiate the data transfer process to the dissemination database through the application, only by click.
2. Application in the background triggers ETL, which, based on the configuration, transfers data to the dissemination database.
3. ETL will send an email notification to the statistician about the success of the action. The status of the action will also be visible through the application.
4. When it comes to the dissemination base, the application further provides the following options
   1. display and search data,
   2. database administration: insert new data, update or delete existing content,
   3. scheduling a date for publication, with the possibility of approval and change the date (with appropriate email notifications),
   4. report on all actions performed on the database.

In order to develop an application for data manipulation of the dissemination database in the first phase (above point 4), the import of Excel templates for data entry would be enabled, along with the execution of data control.

Finishing the application, to cover the described overall process (end-to-end) and the introduction of ETL tool would be developed through future projects.

The application would certainly, already in the first phase, have an administrative part, where it is possible to create users and assign appropriate roles. Here it will be possible to set which of the users can only see the data, who can change, who can delete, who can approve, who can publish.

* 1. General conclusion

The proposed solution would automate a huge percentage of dissemination process, by:

* configuring data processing and control for each survey using ETL tool, which, once set, would be called through the web application to automatically process and store data in the SQL database,
* controlling the whole process through the web application, having insight into all actions, changes, entering data that cannot be automated through ETL and everything else described above regarding web application.

In short, to summarize from the proposal described above, ETL tool would be in charge of the following:

* all data from various sources (excel, SQL database, access database, txt) are placed in a clearly defined sql database for each survey,
* for configuration of all necessary data processing for each survey,
* for configuration of all necessary data controls for each survey,
* to export data in the desired formats (required for external applications, weighting, etc.),
* to import data from various formats (as a result of processing from external applications),
* for configuration of data transfer from working SQL database to the dissemination database,
* logging of all performed actions,
* sending e-mail notifications about performed actions.

Web application will be programmed for following:

* data search and review (working data and dissemination data),
* to control ETL processes (triggering actions configured in ETL tool, after approval etc.)
* monitoring the statuses of each survey,
* showing users who holds the current task over data (for additional processing or approval),
* insight into all actions performed over data (user, action, time report).

Automation enables the following:

* avoiding all the mentioned risks that manual work brings,
* less human and time resources needed,
* avoiding data loss in the process of sending and approving data via email.

1. MONSTAT website
   1. Suggestions for improvement

Analyzing the current state of the MONSTAT website (<https://www.monstat.org/cg/>) we have concluded that there are several weaknesses:

* it’s not responsive,
* it’s not implemented according to current principles of UX design,
* search option is poorly designed - search by document content or metadata is not possible,
* there is no tool for manipulating raw data.
  + 1. Responsive website

A responsive website has a fluid and flexible layout which adjusts according to screen size and orientation. Basically, website will look great and work well on a desktop (or laptop), a tablet, and a mobile phone’s browser.

The number one benefit of a responsive layout is the guarantee that any user on any device will have the best experience possible.

* + 1. UX design

For this large and complex website, as MONSTAT is, the good organization and navigation is of the outmost importance. Including all three major embedded navigation systems, as global, local, and contextual navigation, will reduce the chances that any type of users will become lost.

For the site users, we can recognize and split them into two categories:

* So-called ordinary users - a regular citizen who is not a scientist or a statistician.
* User expert in the use and interpretation of statistics.

Website should be easy to navigate for both types of users with using adequate labelling, phrases and concepts familiar to them. Consistency and standards should be met, users shouldn’t have to wonder whether different words, situations, or actions mean the same thing.

For example, the most important and fresh reports should only be one click away, presented by simple graphs, so that both type of users can draw conclusions about the analysis results. And the sections intended for ordinary users do not need to contain complex reports and data.

Good structure, organization, labelling, browsing, and searching systems all contribute toward effective navigation, and should be improved.

Visual aspect of the website should be simple and easy on the eye, so it doesn’t draw attention from the information. Similar content should be presented by similar components, so users can learn and recognize the pattern. Interface layout should be standardized so that information is presented consistently and for maximum usability. Presentation layer design should create focus, flow and clarity.

Topics that are repeated often or used frequently should be immediately available to the user, without having to search or browse.

* + 1. Searching

A well-designed search benefits both, company and users; it increases conversions, reduces bounce rates, and overall improves the user experience, where user is not required to have a knowledge of the database structure. Good search raises credibility of the organization, especially one like MONSTAT, whose primary business is data. Having that data accessible, GDPR compliant and presentable for all the users on the new website, will present significant increase in client trust and comfort when visiting the website.

* + 1. First level of information

Current website lacks information that is intended for all users, and which is of interest or should be of interest to a large number of citizens. Some of this information is, for example:

* population,
* employment rate,
* unemployment rate,
* gross earnings,
* imports of goods,
* GDP growth,
* inflation rate.

This data should be presented and highlighted on homepage, only with the label and number that represent value of the label, with possibly one addition such as the period to which it relates, or an indication that it is an increase or decrease.

Also, by going deeper into each theme, the main information for the selected topic is displayed, such as:

* for current population: population number, number od women, number of men,
* for hospitals: number of hospitals, number of patients, cost of hospitals.

Decisions on the type of data and the way it is presented should be made by experts from MONSTAT in cooperation with the UX designer who will work on the future project for new website implementation. When it comes to the choice of information that should be found on the website, as primary, it would be ideal to include the opinion of users through survey.

* 1. Dissemination database
     1. Current status

As already pointed out, the dissemination database is not currently available on the website. The data is currently available on the website in the form of an excel file.

On the new website should be developed possibility for the user to have access to the dissemination database through appropriate web components, that will allow access to all necessary data with easy finding of appropriate tables, quick selection of variables and nice display of results that can be further tuned.

* + 1. Conclusion

The dissemination database approach should consist of three steps:

* Table selection
* Variable selection
* Table view

**Table selection**

Selection of the table should be designed to easily find the desired table. The categorization should be clear, with statistical themes as first level, with the possibility of easy movement through the tree view leading to the table.

Each table should be accompanied by the following information:

* description,
* last update,
* contact,
* unit,
* source,
* methodological explanation,
* comment if needed.

**Variable selection**

After table selection, website user should mark selections of the variables and choose between table on screen and file format.

Mandatory variables should be specifically marked to make this information clear.

For each table there should be a choice of appropriate variables, with the possibility to:

* search values in the list of values of variables,
* select all values,
* deselect all values,
* sort values ascending,
* sort values descending.

Finally, the website user has to choose the type of output, like: few layouts of table, excel, HTML, csv, JSON.

**Table view (results)**

After variable and output type selection, result should be presented.

In addition, there needs to be a re-offered option to export data, as well as the ability to edit the results, like

* pivot table manual, or clockwise, or counterclockwise,
* change decimal, or text,
* delete value or variable,
* sum, subtract, divide or multiply variable values,
* sort.

The best and most efficient way to implement a site is in one of the PHP frameworks, as Laravel, in combination with Angular for user interface. Laravel is a web application PHP framework, which allows development reliable and robust websites with modern architectural approaches and clean code.

1. Application for administration of dissemination database
   1. About application

As we have already pointed out above, the dissemination database exists, it’s filled with data through SQL wizards, and no one, except the IT sector, has access to the data. In addition, it is not used in practice, because there is no adequate application for control, editing and exchange of data by the appropriate MONSTAT employees.

As part of the project currently underway in MONSTAT, an application for dissemination database administration is being developed.

Dissemination database management application involves the following activities, for every statistical survey:

* user administration and assignment of user (MONSTAT employees) access rights,
* search and display dissemination data,
* updating of existing dissemination database contents,
* approving data for the publication,
* setting the date for publishing data,
* export data into appropriate formats,
* report about activities over data (who, what, when)
* locking data changes after publication with possibility that only users with certain rights can change the data (with the indication that the data has changed).

The existence of this application would:

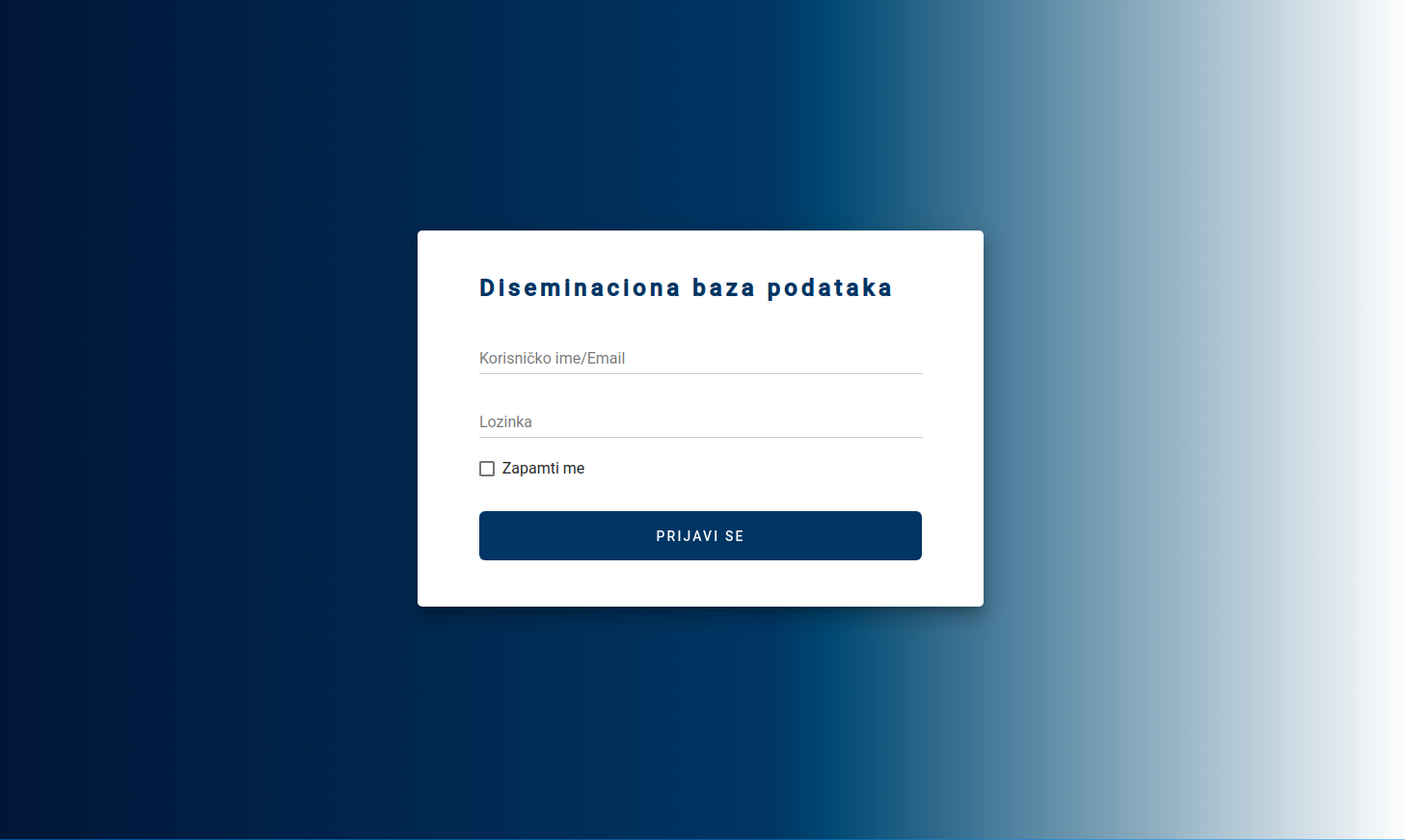
* enable the process of administration of the dissemination database by statisticians,
* reduce the risks that manual administration brings,
* enable data quality control,
* enable planning and the start of the project: using dissemination database on the website.

This application also represents the starting point of a future web application that will be part of the recommended information system described in the text above.

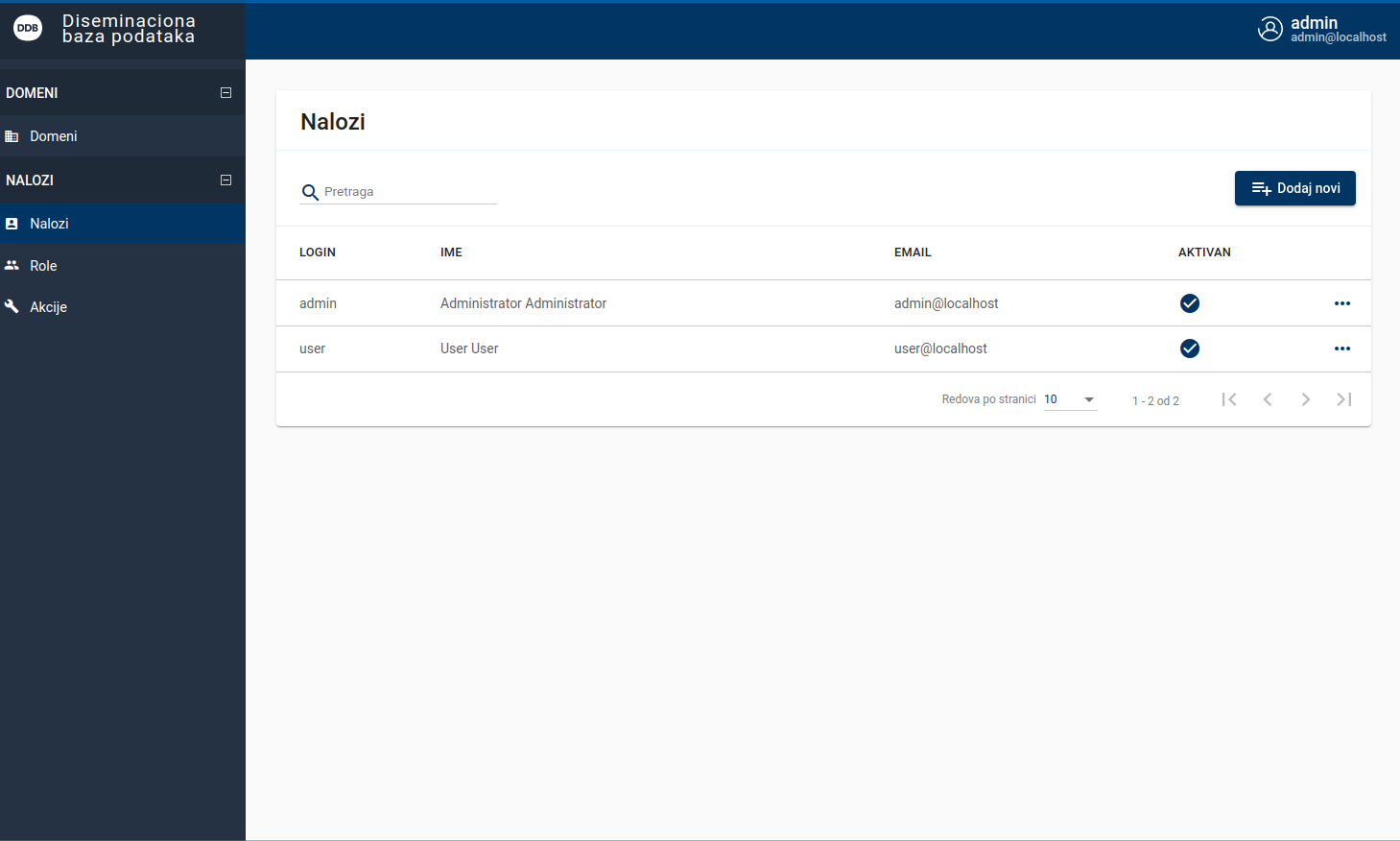
* 1. User rigths management

Web application for administration of dissemination database is single-page web application, accessible through a URL, username and password. The user of the application only needs to have internet access on his computer, in order to be able to use the application.

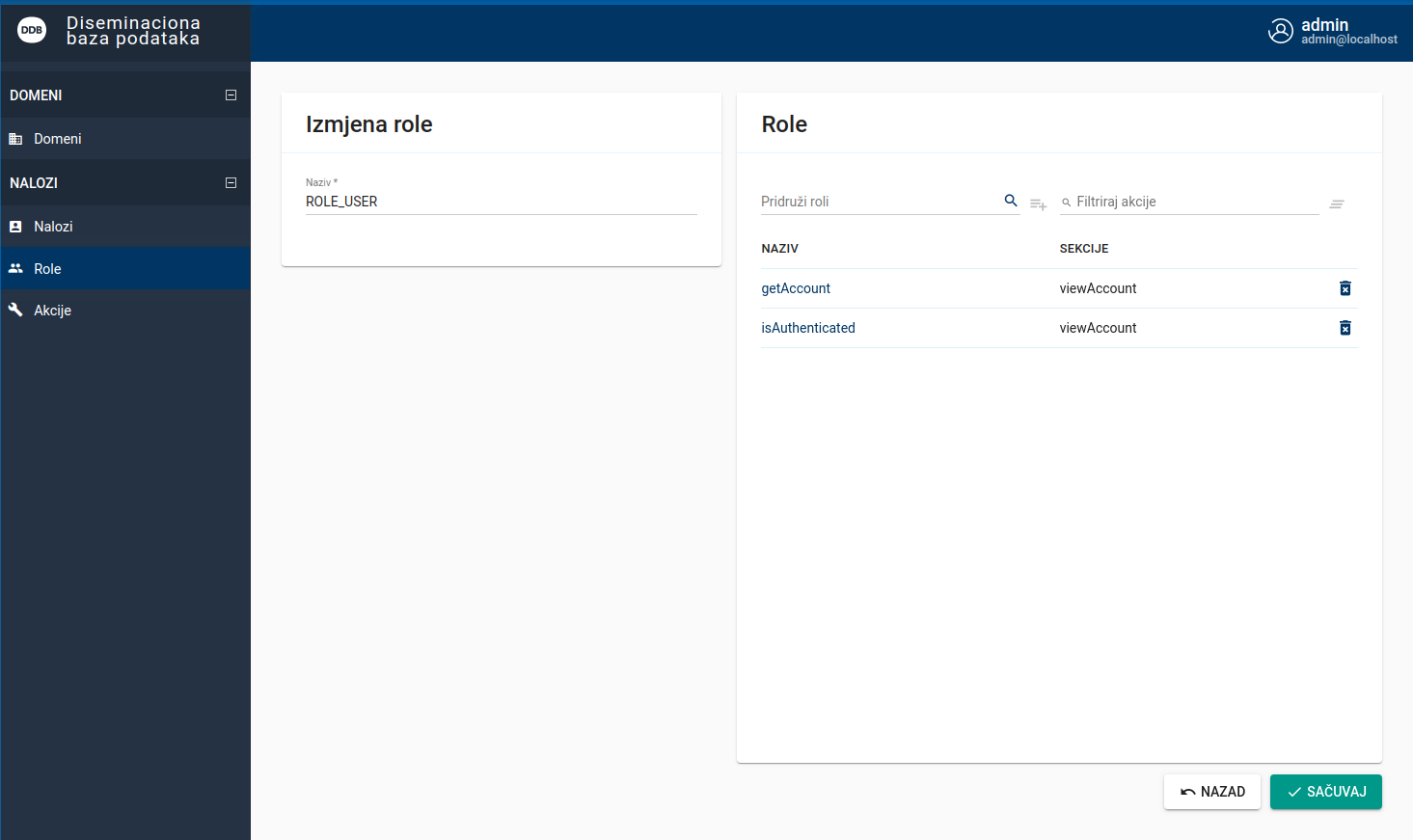
All users created by the administrator have the right to access the application and perform actions defined by the rights granted by the administrator.



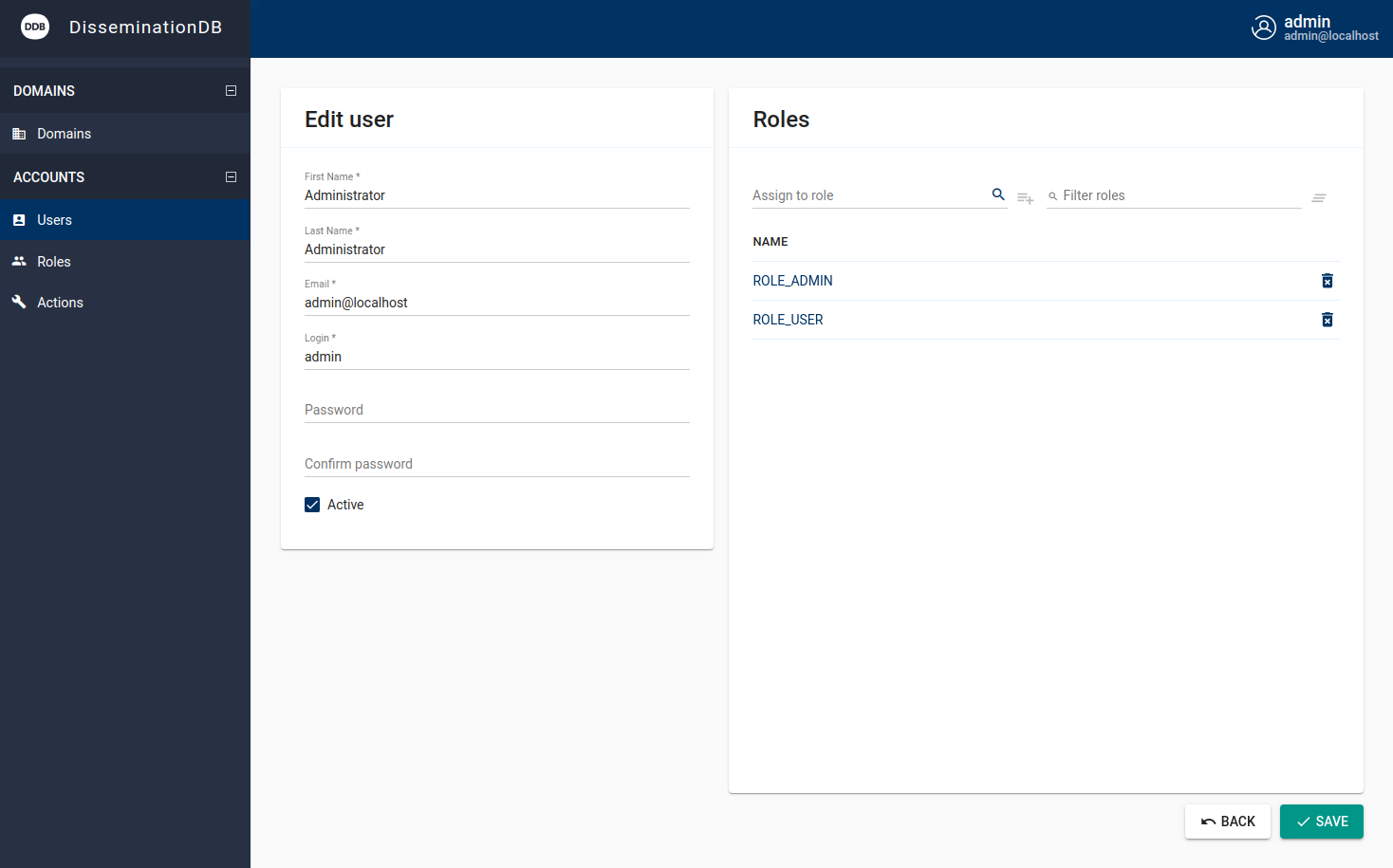
Picture 1: Login page, for enter username and password.



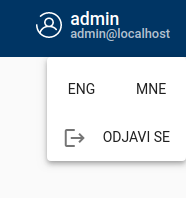
Picture 2: User administration page. List of exiting users: username, name, email, status. Possibility to add new user, edit or deactivate existing.



Picture 3: Page for creating roles with assigning rights (as actions) that role can perform through the application.

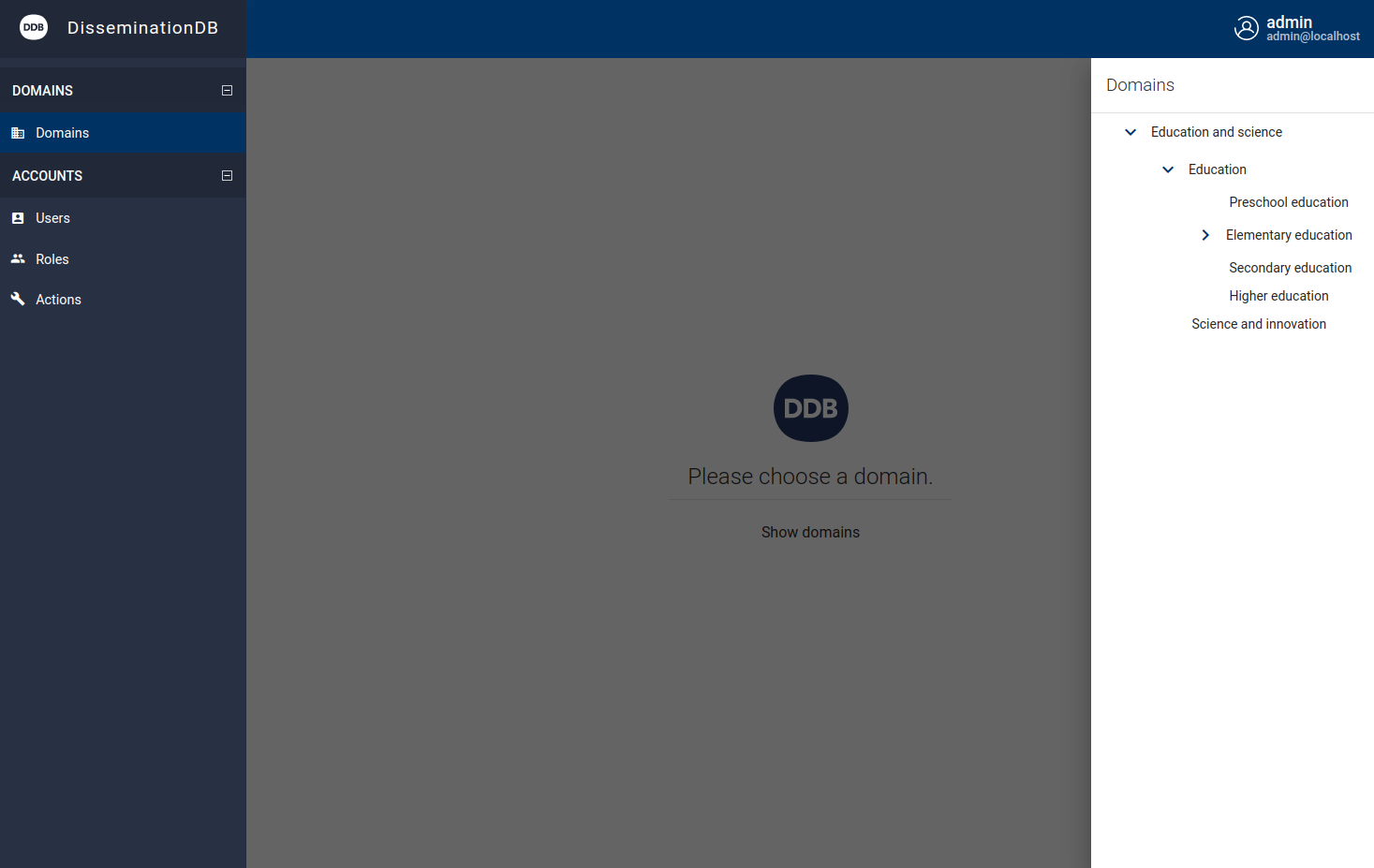


Picture 4: User assignment page. Each user can have one or more roles.

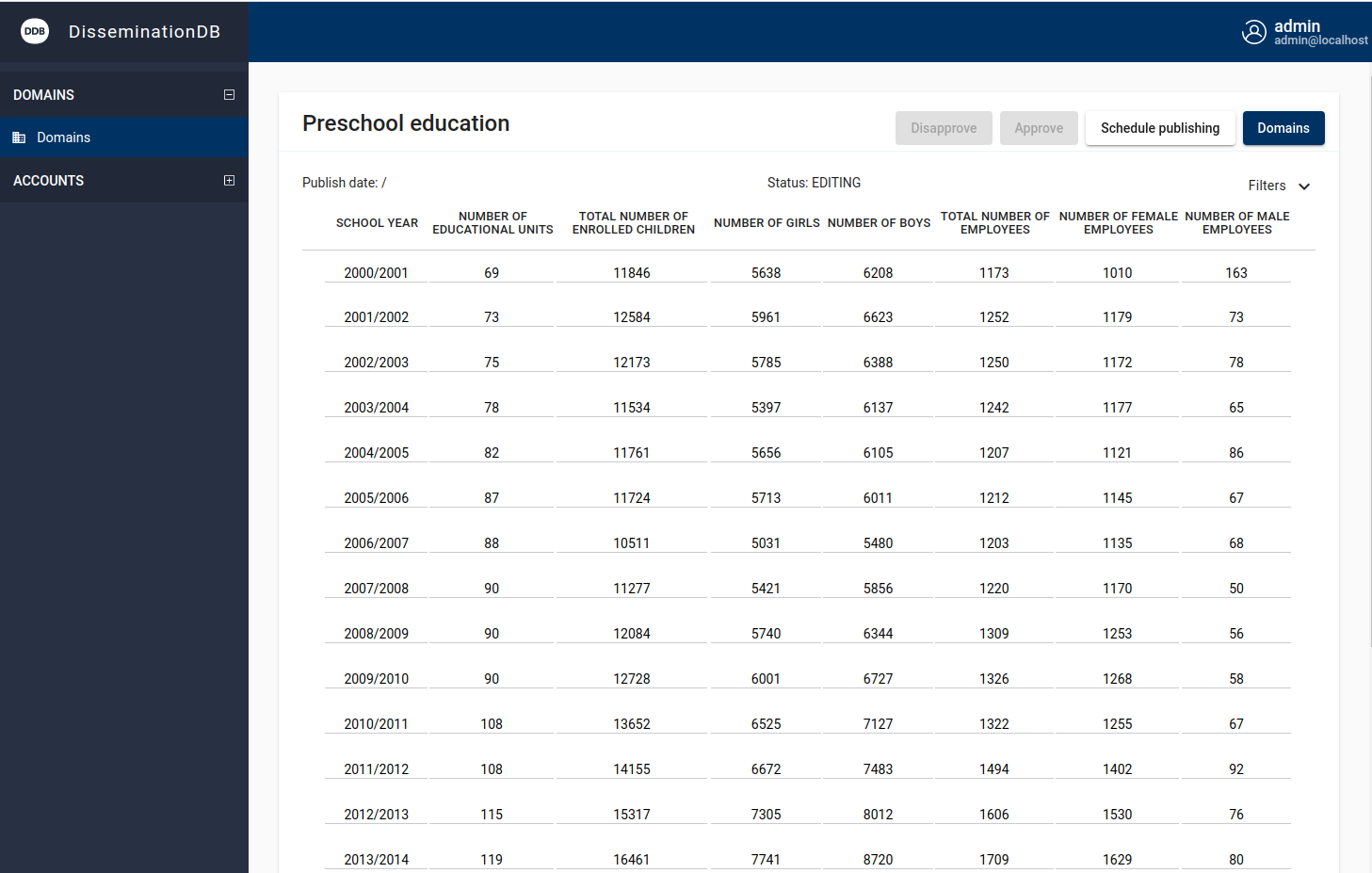
 To emphasize that the application is bilingual, the choice of Montenegrin and English language is enabled.

* 1. Dissemination data administration

We said that the application allows data search and modification. To make it easier to get to the table to be viewed / modified / approved, a display as tree view of statistical themes is enabled (domains)



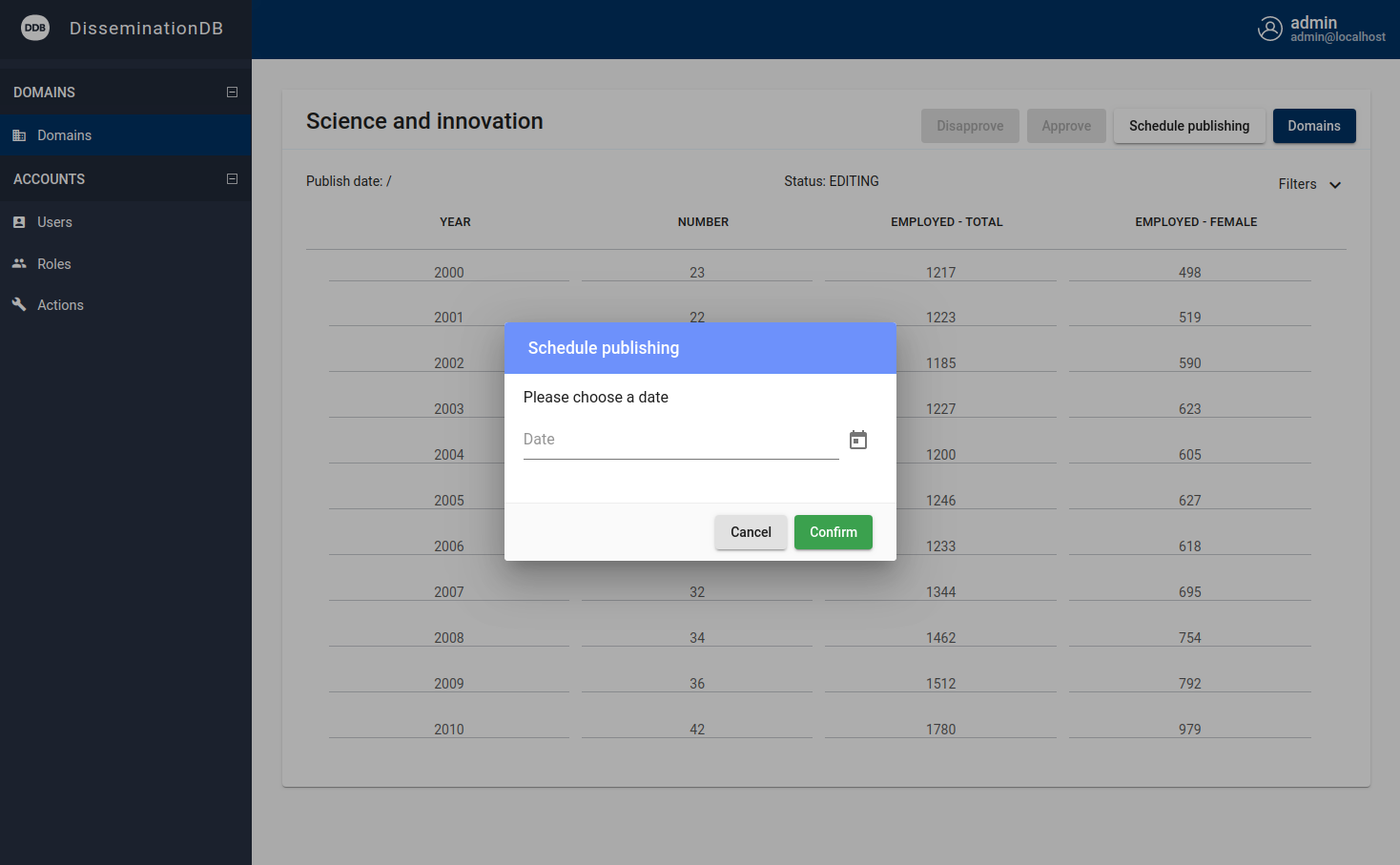
Picture 5: Tree view of statistical themes. The goal is to easily get to the desired table.



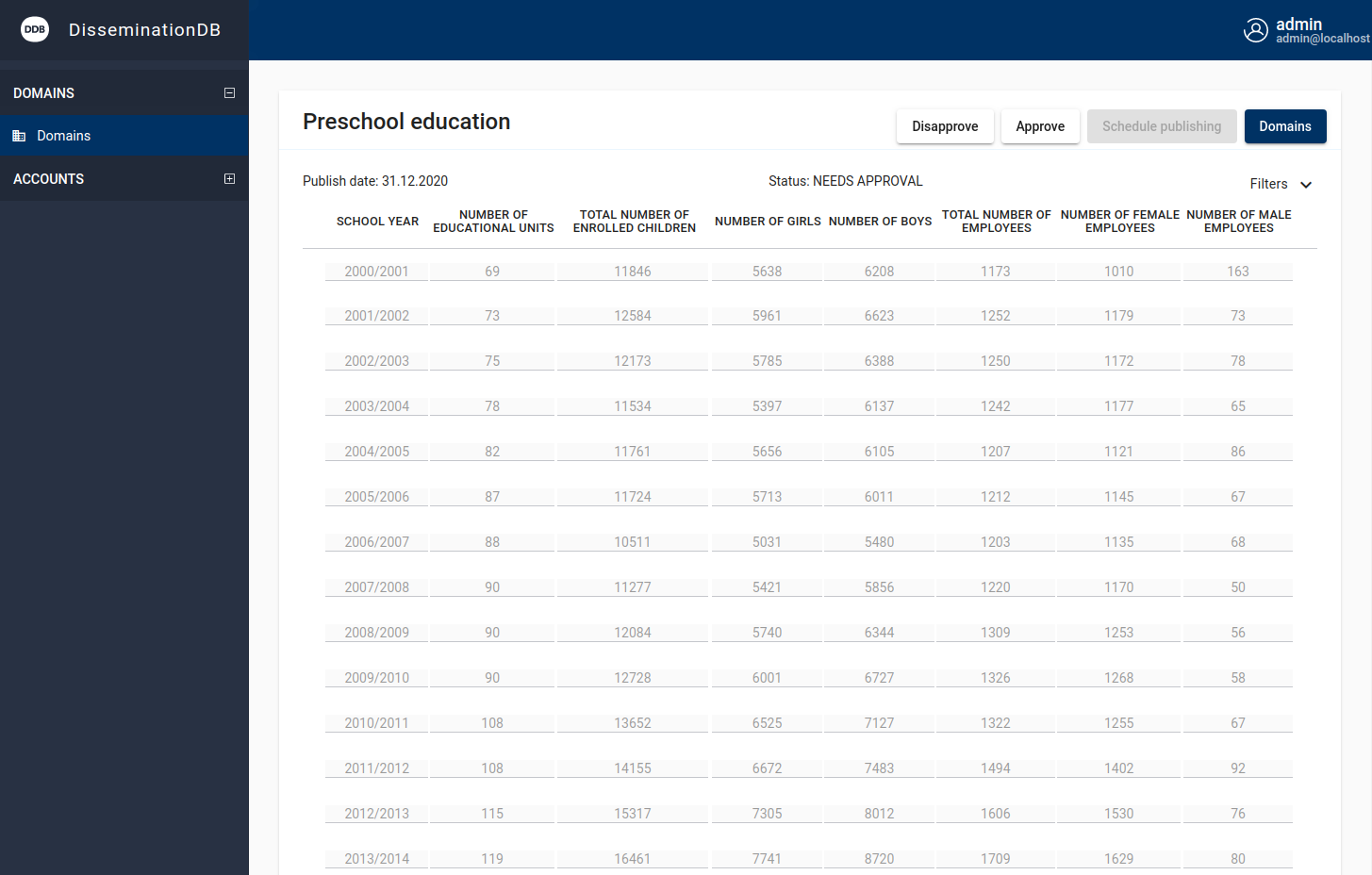
Picture 6: Preschool education table is chosen from above tree. By selecting the table, the tree closes and can be reopened by clicking the Domains button.

Displayed table is editable, which means that a user (who has required rights set through application by administrator), can modify any field in the table.

We also see here button for setting the date for publishing data: Schedule publishing.



Picture 7: Clicking the button *Schedule publishing* opens a module for scheduling a date for publishing data. It can be changed at any time by the user who has adequate rights.



Picture 7: Once the release date has been set, both the date and the data need to be approved. The application no longer allows data to be changed until the status is changed by the appropriate user. Data and date can be approved or disapproved. If disapproved, responsible statistician need to process the requests, left as a comment through the application by the superior, and set the status for approval again.

At any time, the status of the data of the selected table and whether the publication date has been set can be seen on the screen.

If the table has a large number of rows, it can be searched by clicking the Filters button (which opens all necessary filters). It will be possible to search data through all elements recognized as important for searching data by MONSTAT.

The application will be completed to fully comply with the processes required to control the dissemination base, as described in Section 4.1.

This gives us an excellent basis for upgrading, so that the application in some future phases, covers all processes in MONSTAT, as proposed in the document, and thus provide a high level of data control and quality. This is the first step towards building a system that will be a real ally for MONSTAT to maintain its official statistics principles.