**Data integration - idea for reduction of complexity**

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**Abstract**

*MONSTAT conducts hundreds of surveys every year and prepares dissemination covering virtually every aspect of statistics in the Montenegro. Our mission is to provide timely, accurate, and useful statistics in service to the government of the Montenegro. Despite complexity of surveys and the large volume of data processed daily, the most important goal is to provide precise, timely and reliable data. The most usual way of processing data of a statistical survey is a, so-called, stovepipe principle, where the complete process is performed – from data entry to publishing the results separately for each survey. Therefore, NSIs have a situation where the processing of statistical data is done on various platforms, implemented on a variety of software tools, with data stored in various ways, separately for every survey, and even worse, for every statistical phase. Many of NSIs overspend on technology in the quest for getting value for the institution. They need to manage large IT structures, which are very expensive and slow, in order to approve capital investment and operational costs. One of the key distinguishing factors of statistical offices is data integration. Other organizations and enterprises may have better insight in individual sources but NSIs know best how to combine data and turn them into reliable figures describing the whole society. We gradually put all data on one platform. In that way we got all the functionalities of a warehouse. We made a uniform approach to all surveys, put all information about every piece of data in one place and made a single tool to handle all that information and data. That is IST Integrated system of data processing. IST was designed, developed and implemented in four NSIs and present example of international collaboration in data integration area.*

**Keywords:** data processing, integration system, data integration area.

1. **Introduction**

With purpose of more complete understanding the transformation of the institutional framework of Statistical System of Montenegro, at the very beginning we consider important to point out to the most important events in the recent history of Montenegro that represented the conditions for the reform of social and economic system. Namely, at the end of 20th century and at the beginning of 21st century there happened a revolutionary change of total social system when planned economy (collective ownership over resources for production) was replaced with market economy based on private ownership. The federation of six republics with one-party authority was reorganized in the market economy based on private ownership with multi-party system, resulting at the end in renewal of Montenegro independence in 2006. The change in the arrangement of society and government caused strong changes in the Montenegrin statistical system, before all, due to leaving the statistical system of previous social organization that it was an integral part of almost for a half of century. One of the first reforms in years of renewed independence of Montenegro, and building of new economic system referred to the development of new concept of Montenegrin statistical system[[1]](#footnote-1). An analysis preceding it indicated that the statistical system of Montenegro is mainly based on national methodologies, incoherent, without a clear responsibility for data quality, and administrative capacities not developed to perform independently all statistical process phases, having in mind that MONSTAT was responsible for longer period for data collection, while methodology development, data processing, and international cooperation were done by Federal Statistical Office. The purpose of reform was to build a new, interinstitutional networked system which is exclusively based on international methodologies for collection and processing of data for the official statistics purposes. The reform of Montenegro statistical system is defined within 6 phases[[2]](#footnote-2):

* Adopting the statistical system concept and nominating reform coordinator institution;
* Implementation of reform through three alignment components (legal, methodological, and information);
* Education of producers and users of official statistics;
* Linking administrative databases at the country level;
* Opening the data for citizens (open data);
* International integration of statistical system of Montenegro.

Today, after only 12 years after the renewal of state independence, we succeeded to establish and define with separate legislation the statistical system of Montenegro, with Statistical Office of Montenegro – MONSTAT as its coordinator; then to align methodologically an important part of official statistics with the EU standards, and independently carry out the largest two statistical actions (2010 Agriculture Census, and 2011 Census of Population, Dwellings, and Households)[[3]](#footnote-3). In parallel with defining legislation and methodological alignment, we worked on the IT modernization of statistical processes with the purpose of establishing an integrated system and increased use of administrative data sources for the official statistics production. As demands towards NSIs are growing, searching for new solutions intensiﬁes in aimed to reduction complexity of the surrounds statistical production. In cooperation with the Statistical Office of Serbia, we implemented the vision of the development partnership and applied the IST (Integrated system of data processing) Having in mind the bases on which the institutional reform of statistical system was started, the conclusion can be drawn that a significant success was achieved and firm bases were set up for long-term development of statistical system of Montenegro, as mentioned in the open negotiation process with the EU for official statistics (negotiation chapter 18: Statistics).[[4]](#footnote-4) Anyhow, clearly defined long-term vision of statistical system as an integral part of total Montenegrin social system reform[[5]](#footnote-5); by adopting the Commitment of Confidence by the Government of Montenegro, which showed the commitment to strengthening the trust in official statistics, based on European principles and quality standards of official statistics, which further strengthened the professional independence of the Statistical Office and contributed to the fulfilment of the obligations of the negotiating chapter 18 statistics; continuous education of MONSTAT staff members, and EC assistance programmes implemented in cooperation with and with expert assistance of Eurostat; contributed to it. But, having in mind the challenges defined by the ESS 2020 as well as by Transformative Agenda for official statistics aimed at supporting the post-2015 development agenda, further transformation of Montenegro statistical system will only be possible with further staff education and investments in IT system which will enable more efficient collection, processing, and integration of statistical data, both those collected by MONSTAT, and those owned by other national authorities.

1. **Concept of new statistical system of Montenegro**

Transformation of institutional framework of Montenegrin statistical system was based on three pillars:

1. ***Legal consistency*** – adoption of the first Law on Official Statistics of Montenegro and herewith alignment of other regulations;
2. ***Methodological consistency*** – adoption of international methodology by which the entering the data reached by implementation of internal methodologies and classifications in the official statistics system is not possible;
3. ***Information consistency*** – by which the establishment of information system that supports the concept of official statistics system (implementation of integrated system of data processing – IST and linking administrative data sources used for the purposes of official statistics) is enabled.

The reform of Montenegro statistical framework has started with the adoption of Law on Official Statistics of Montenegro in 2005, by which the statistical system of Montenegro was for the first time defined as an independent system with the aim to do all phases of statistical survey (collection, processing and dissemination) at the national level, and in line with international standards. The adoption of the first law on official statistics was followed by an education of producers and key users of official statistics, via three separately structured Schools of Official Statistics with 3 to 6 months duration. The first education under title *‘Education in function of implementing the Law on Official Statistics and Statistical System’* was organized in 2006; the second one under title *‘Statistical system of Montenegro – statistical bases*’ was organized in 2007; and the third one *‘Importance of official statistics in the EU integration process*’ was organized in 2009[[6]](#footnote-6). Approx. 100 representatives of official statistics producers, administrative data source institutions, and key data users successfully finished the mentioned education programmes, what was of key importance toward the aim of creating staff resources that later participated in the realization of reform, before all, in the harmonization process of Montenegro official statistics with the EU standards. With purpose of strengthening the coordination role of Statistical Office of Montenegro, the Law on Official Statistics and Official Statistical System was amended in 2012. Statistical Office of Montenegro becomes the main coordinator of the statistical system of Montenegro. New Law defines that the MONSTAT shall be the main holder and disseminator of statistical data as well as responsible professional body, organiser and coordinator of official statistics system, and it shall represent the official statistics of Montenegro in the international statistical system. Since 2012, all principles of official statistics production that are defined by the Regulation (EC) No 223/2009 are a constituent part of the law on official statistics of Montenegro. If we look at the reform results from the EU’s point of view, we can draw a conclusion that Montenegro has achieved a significant success in term of institutional framework reform and “*the EU notes that Montenegro's statistical infrastructure is in line with the formal requirements of the acquis”*.[[7]](#footnote-7)

Nevertheless, although significant results are achieved within the institutional reform, a key challenge of further transformation is still methodological harmonization with the EU standards and strengthening of human resource.[[8]](#footnote-8)

An important challenge in MONSTAT transformation process remains the introduction of new method and information technologies in data collection and processing:

1. **Use of Big Data in all aspects of official statistics production as well as**
2. **Data integration - idea for reduction of complexity.**

When considering Montenegro, MONSTAT has invested in the staff education from the very beginning, but meeting new challenges for creating future staff potentials whose education is based on new platform, which refers to Big Data and the introduction of a European master in the field of official statistics in the national education system.

One of the universities in Montenegro - University of Donja Gorica, founded postgraduate studies "*European master in the field of official statistics - EMOS*", which were accredited by a special EU body and which started with implementation in early 2017. We provided a possibility to EMOS students to represent to MONSTAT ideas/projects in advance created for the innovation of statistical processes and testing of already available data sources for production, for whose implementation MONSTAT will provide financial, technical, and other conditions. We believe that in this manner, in addition to the existing education programmes, we will give a new impulse for the development of Montenegrin statistical system.[[9]](#footnote-9)

**Data integration - idea for reduction of complexity – IST**

IST (Integrated system of data processing) is a concept of integrated data processing. Covers all stages of production from data entry to data dissemination, it is based on a simple metadata and its interpreter and its compliant with GSBPM model. Data processing is uniform, easy to make, easy to maintain, does not depend on technological changes and does not depend on buying expensive licenses. It provides (1) overview all variables used in statistical production; (2) overview all classifications used in statistical production; (3) road to standardization of statistical units. Statistical Ofﬁces of the Republic of Serbia,[[10]](#footnote-10) Montenegro, Bosnia and Herzegovina and Albania, has developed System of integrated data processing – IST.

IST is a .net platform and wemade a uniform approach to all surveys (data entry, processing and reporting at one place). IST allows easy applications and data sharing and using software that we already have. Other benefits of using IST is that IST have unique interface regardless of statistical domain or questionnaire type and put all information about every piece of data in one place making a single tool to handle all that information and data. In many ways it can reduce data complexity.

Benefits for institution is that it can integrate data, transform system to be GSBPM compliant, activate metadata for everyday production, empower staff skills and ﬂexibility and reduce costs.

With IST we made changes in organizational culture. Our goal was and is to empower employees to achieve more, to become data scientists - someone who is better at statistics than any software developer and better at software developing than any statistician. We need individuals at every level to gain the skills and knowledge. It is the only path to empower an institution.

***Issue***

For any company, and IT within it, the problem arises if we approach a large number of applications in the traditional way, which is to make special applications for every research/project. It may then happen that applications are developed using different platforms, that data is stored and processed in different places, from the server to the local machine, in various formats, from relational database to text ﬁles.

***Approach***

We needed a development environment in which there is no programming, in which the applications are uniform, standardized, easy to make and not dependent on constant technological changes (new development tools, programming languages, platforms). We needed to have all data on same platform, even more, having it on same type of format or same type of relation database. It was obvious that going towards full data integration, from both the IT and statistical aspects, had been critical to ensure that data reached its maximum potential.

***Solution***

We decided that the basis of all should be what we know best - relational databases. Certainly the data are entered into the databases and reports are made against them. How about, besides storing data in databases to store applications in database, as well? We came up with the idea that it would be best to somehow describe the application in detail, to keep this description in a metadata database, and to develop a program that will interpret this knowledge base and in real time generate (based on descriptions from that database) and run data entry, data checking, data validation, data editing, advanced search with connecting data from different surveys, reporting and data processing.

So we came to the following concept:

A simple metadata database - IST metadata,

A metadata interpreter - IST interpreter

**IST is on Windows platform, IST metadata is in MS SQL server, IST interpreter is .NET interpreter**

One simple metadata database (IST metadata) has all relevant information about data and with description.

One .NET application that literarily reads data from IST metadata and interprets them interpret this knowledge base and in real time generate (based on descriptions from that database) and run data entry, data checking, data validation, data editing, advanced search with connecting data from different surveys, reporting and data processing.

**IST interpreter modules:**

* Updating of the IST metadata
* Real time generated data entry
* Web apps generator
* Batch logical control
* Data checking, data validation
* Data editing and data correction
* Batch automatic correction
* Advanced search of individual and aggregated data from the various databases
* Generating reports
* Data management
* Managing procedures in database containing individual and aggregate data

**Key features of IST are same as key features of GSBPM**

Modules of IST interpreter are loosely coupled, i.e. they are independent of each other, each module is one phase of statistical production, modules do not have to be followed in a strict order and IST modules are independent of each other. You can have as many iteration of some phase as is needed.

For statistical offices benefits of using IST are reflected in strategy for full data integration, faster development of IT solutions, improving collaboration among the IT and statistical divisions together with standardization of statistical data processing. Important is that IST allows standardization of data input and output IT staff ﬂexibility in one platform – Microsoft and there is one program and one metadata database where users should have basic knowledge of windows.

Great benefits for governments are seen in responsive national statistical service where can been seen decreasing of cost and time and increase of quality of information. Uniﬁed approach and uniformity of data processing can give better coordination among government ofﬁces. In-sourcing is a way for drastically decreasing budget funds previously reserved for buying specialized software  and easy adjustment to data processing requirements in different institutions and it is easy to understand among subject matter experts.

Very important is to emphasize that tailor made IT solution that can be implemented in other government ofﬁces.

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1. The Government of Montenegro entrusted the independent economic institute (Institute for Strategic Studies and Projections) with the definition and establishment of new statistical system that follows the logic of new economic system of Montenegro. The leader of the reform which lasted in 2001-2008 period was Mr. Veselin Vukotic, PhD - <http://www.udg.edu.me/en/>. [↑](#footnote-ref-1)
2. Vukotic, Veselin (2003): Concept of new statistical and information system of Montenegro, Institute for Strategic Studies and Projections, Podgorica, p. 2. [↑](#footnote-ref-2)
3. As MONSTAT carried out for the first time independently the 2011 Population Census, it is said in the report conclusion (EC-Eurostat, 2011:27): “In addition, the mission noted with appreciation the high standard of professionalism of the staff involved at all levels in the census, from Monstat as well as temporary staff. The mission considers that the census has achieved a high level of quality, especially in terms of accuracy and timeliness”. [↑](#footnote-ref-3)
4. Negotiations of Montenegro with the EU in area of official statistics were opened on 16 December 2014. [↑](#footnote-ref-4)
5. Key development megatrends according to which new institutional framework should be built (Vukotic, 2005: 17) are defined as: i) globalization which defines many things in national economic system and to which the system must be adapted; ii) decentralization (network organization instead of hierarchy) and iii) from short-term to long-term – perceiving long-term processes. [↑](#footnote-ref-5)
6. Schools of statistics were organized by Institute for Strategic Studies and Projections under project ‘*Concept of New Statistical and Information System of Montenegro‘* **-** [**http://issp.me**](http://issp.me) [↑](#footnote-ref-6)
7. European Commission, Directorate- General Enlargement: “The draft common position following Montenegro's Negotiating Position CONF-ME 9/14)”, Brussels, 22 September 2014, 13456/14, pages 3-4 [↑](#footnote-ref-7)
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9. In line with Cooperation Agreement, MONSTAT educates statisticians for area of statistics at the University of Donja Gorica for a longer period. Out of total number of staff members, since 2010 to nowadays there are 20% of those with finished master or doctoral studies. Currently, five staff members of MONSTAT are finishing “European Master of Official statistics” at the University of Donja Gorica. More details: <http://www.udg.edu.me/en/> [↑](#footnote-ref-9)
10. <http://webrzs.stat.gov.rs/ISTSite/IST_Home.aspx> [↑](#footnote-ref-10)