
FINAL REPORT

**Strengthening of Statistics Health
Information System and its
Harmonization with EU Requirements**



Information System of Health Indicators

Contract No. 200300499503-0601-0003

Elaborated by::

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	FINAL REPORT Strengthening of Statistics Health Information System and its Harmonization with EU Requirements Information System of Health Indicators Contract No. 200300499503-0601-0003	

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Used abbreviations

Abbreviation	Description
ASCII	American Standard Code for Information Interchange
AU	Announced Unit
CCTA	Central Computer and Telecommunications Agency
CFCU	Central Finance and Contract Unit
CRHCP	Central Register of Health Care Providers
CRMS	Central Register of Medical Staff
CSV	Comma Separated Value
DMZ	Demilitarized zone
EU	European Union
GUI	Graphical User Interface
HCP	Health Care Provider
HCSA	Healthcare Supervision Authority
NHIC	National Health Information Centre
IHIS	Institute of Health Information and Statistics, since 01. 03. 2005 transformed into National Health Information Centre.
ISO	International Standards Organization
ISHI	Information System of Health Indicators
J2EE	Java 2 Platform Enterprise Edition
LAN	Local Area Network
MIS	Management Information System
MS	Microsoft
ODBC	Open Database Connectivity
OECD	Organization for Economic Co-operation and Development
OLAP	Online Analytical Processing
OMG	Object Management Group
PPN	Public Private Network
RU	Reporting Unit
SAD	Small Auxiliary Database
SR-MH	Ministry of Health of the Slovak Republic
SR	Slovak Republic
SRU	Set of Reporting Units
STN EN ISO	Slovak Technical Standard for the Quality Management System
SW	Software
UML	Unified Modeling Language

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Abbreviation	Description
WHO	World Health Organization
XLS	Microsoft Excel File Format
XML	Extensible Markup Language

1. Introduction

1.1. Document objectives

This document is the final assessment report of the "Development of Health Indicator Information System (ISHI)" project for which conditions were created by outputs of the Twinning Light Project no. 2003-004-995-03-06 on "Strengthening of Statistics Health Information System and its Harmonization with EU Requirements".

1.2. Document contents

Chapter One of the document explains the purpose and content of the document, contains references to other documents and a glossary of terms and abbreviations.

Chapter Two describes the project goals, input conditions, parties to the contract, requirements for the solution, and deliverables to the project.

Chapter Three contains the results of project execution from the point of view of goals, benefits, problems and recommendations for the system operations and a brief financial report.



Chapter Four describes the project solution.

1.3. Document references

This document is associated with the project documents listed in the table below¹:

Document ID	Document title
SP	Documents of a tender for the Development of a Health Indicator Information System
ZML	Contract no. 200300499503-0601-0003 for the Development of a Health Indicator Information System
ZML-1	Amendment to contract (ZML) extending the contract term from 6 to 7 months
PON	Bid of company SOFTEC s.r.o. in a tender for the Development of a Health Indicator Information System
Zi	Minutes of a meeting of providers and recipients during solution of project no. i where i ranges from 1 to 17
ANLS	Document Analysis of ISHI Requirements, version 2.0 – deliverable no. 5 according to <i>Introductory Report</i> [INCPTNR]
DSGN	Design of ISHI system, version 2.0 – deliverable no. 7 according to <i>Introductory Report</i> [INCPTNR]
IMPLTST	Implementation and testing plan, version 1.0 - deliverable no. 8 according to <i>Introductory Report</i> [INCPTNR] – appendix to <i>Work Reception Protocol</i> [POPZ]
PLT	Attendance lists of training courses - deliverable no. 9 according to <i>Introductory Report</i> [INCPTNR] – appendix to <i>Work Reception Protocol</i> [POPZ]
KLSP	Requirements performance checklist – appendix to a <i>Product Acceptance Testing Protocol</i> [PAT]
ZVAT	List of acceptance tests made – appendix to a <i>Product Acceptance Testing Protocol</i>

¹ References in the text state the document ID in square brackets [], e.g. [SP].

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Document ID	Document title
	[PAT]
PAT	Product Acceptance Testing Protocol - deliverable no. 10 according to <i>Initial Report</i> [INCPTNR]
POPZ	Work reception protocol - deliverable no. 11 according to <i>Initial Report</i> [INCPTNR]
INCPTNR	Introductory report to ISHI Project, version 2.0 – deliverable no. 1 according to <i>Initial Report</i> [INCPTNR]
INTRMR1	Interim report no. 1 of ISHI Project, version 2.0 – after stages <i>SW Development</i> and <i>Document creation</i> – deliverable no. 2 according to <i>Initial Report</i> [INCPTNR]
INTRMR2	Interim report no. 2 of ISHI Project, version 2.0 – after stage <i>Training Course</i> - deliverable no. 2 according to <i>Initial Report</i> [INCPTNR]
INTRMR3	Interim report no. 3 of ISHI Project, version 2.0 – after stage <i>Implementation and testing</i> - deliverable no. 2 according to <i>Initial Report</i> [INCPTNR]
ZA	Minutes of administrative meeting on 1 December 2006 which launched the project – appendix to <i>Initial Report</i> [INCPTNR]
1	Fowler, M.: <i>Analysis Patterns. Reusable Object Models</i> . Addison Wesley 1997
2	Šešera, L., Mičovský, A., Červeň, J.: <i>Datové modelování v příkladech (Data modeling examples)</i> , Grada 2001

1.4. Terms and abbreviations



The following list of terms provides the terms in alphabetical order which may be differently interpreted. For each term the detailed explanation is provided. Abbreviations with definitions are also included. In the definition part, single standing terms are indicated in bold.

For the sake of completeness, the list contains terms and abbreviations defined in the requirements analysis and new terms and abbreviations used in this document are added.



Term	Definition
Announced unit	Part of RU about which RU gives reports according to its reporting duty to the given statistical survey.
Application function	Named part of the programming code with defined inputs and outputs providing specific functionality of software system for the respective application / objective field, as opposed to technologic functionality.
ASCII	American Standard Code for Information Interchange
Attribute	Basic element of the class.
AU	Abbreviation for Announced Unit.
CCTA	Central Computer and Telecommunications Agency
CFCU	Central Finance and Contract Unit
Class	Complex data type with structure consisting of basic elements. Basic elements are attributes (synonym for items). Database table is the mostly used data entity in conventional relational database. In more modern technologies, data structure can be more complex and may include functionality.
Component	Term introduced in SAD. Statistical data serving for the calculation of statistical indicator. Majority of HI is represented by just single component.
Cost centre	Part of the organization being monitored and evaluated for economic data.
CRHCP	Abbreviation for the Central Register of Health Care Providers. It contains license data for healthcare provision completed by data resulting from statistical survey.
CRMS	Abbreviation of the Central Register of Medical Staff.

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Term	Definition
CSV	Comma Separated Value – type of a text file containing items separated by agreed separator. Following separators are assumed within this project - comma, semicolon or tabulator.
Data diagram	Diagram containing data entities and relations between them. In the UML language it is called class diagram (or static structure diagram).
Data element	Status of data entity within the given attribute, individual data for a statistical unit; this can be also sorting character, e.g. items in reports.
Demilitarized zone	Part of computer network separated from the internal organization network as well as from the internet. It shall provide safe separation of internal computer network from the internet.
Design	Stage of the software system development. In the RUP methodology, it follows after the stage <i>Analysis</i> . The goal of this stage is to specify the system architecture in detail as well as use cases for the selected programming environment.
Diagram of activities	UML language diagram. Often used for graphic presentation of <i>Process</i> .
DMZ	Abbreviation for demilitarized zone.
EPIS	Infectious Disease Monitoring Information System for Public Health Offices
EU	European Union
External interface	Interface to the other software system. In the case of conventional software systems, data structure for sending data from the one system to the other was assumed. For modern systems, also another aspects can be added such as the name of called service / function etc.
FAAST (FAAST C++)	Framework developed by the company Softec for the design of client/server applications featuring thick client.
FK	Foreign Key.
Framework	Supporting structure applicable for the development of software systems. Typically it consists of code libraries, auxiliary software and scripting languages helping the developer to design and interconnect software system components.
GUI	Graphical User Interface
HCP	Abbreviation for Health Care Provider
HCSA	Healthcare Supervision Authority
Health Care Provider	a) NP or LP providing healthcare based on permission under the Act No. 578/2004 § 3 Section 4 b) or b) NP, providing licensed healthcare under the Act No. 578/2004 § 3 Section 4 c) or the Act No. 578/2004 § 3 Section 4 d).
Health indicator	Numeric data item of the ISHI system being object of outputs which are provided to various users.
HI	Abbreviation for Health Indicator.
NHIC	National Health Information Centre. The organization, the original project recipient ISHI – IHIS was transformed into.
HTU	Higher territorial unit. Self-governing body with the competence to approve operation of the medical facility.
IDMIS	Infectious Disease Monitoring Information System for Public Health Offices (also abbreviated as EPIS)
IHIS	Institute of Health Information and Statistics
Indicator	Aggregated statistical data.

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Term	Definition
ISO	International Organization for Standardization
ISHI	Information System of Health Indicators
Item	Synonym for attribute.
J2EE	Java 2 Platform Enterprise Edition
LAN	Local Area Network
Logical collection	It is defined by single form – and by reporting duty of the RU towards the form.
LP	Legal Person
Manager information system	Software technology based on data storage in the form of multidimensional cubes. It is primarily applied for complex or ad hoc data analyses.
ME	Abbreviation for Medical Employee.
Medical employee	Physician, dentist, pharmacist, nurse, midwife, laboratory technician, assistant, technician, other medical staff.
Medical facility	Facility in which healthcare is provided on the basis of license granted by SR-MH or HTU. Field of activities provided in the respective facility shall be specified in the license. Relation between medical facility and its special departments is not exactly regulated.
MF	Abbreviation for Medical Facility
MIS	Abbreviation for Management Information System
MS	Microsoft
Notified unit	Part of RU, about which RU is giving report according to its reporting duty for a given statistical survey
NP	Natural Person
NUTS	Categorization system of regional and statistical units (according to the French name Nomenclature des Unités Territoriales Statistiques) elaborated by Eurostat which serves for purposes of social, economic and structural analyses of territorial units.
ODBC	Open DataBase Connectivity
OECD	Organization for Economic Co-operation and Development
OLAP	Online Analytical Processing
OMG	Object Management Group
Permission holder	NP or LP granted permission by competent administration body to operate health facility.
PGSS	Abbreviation for Program of Governmental Statistical Surveys.
Physical collection	For the respective RU it is defined by any forms having reporting duty to RU.
PK	Primary Key
VPN	Virtual Private Network
Process	Sequence of work activities applied in the respective organization/enterprise in line with the mission of the organization/enterprise usually leading to production or provision of services. Activities can be both non-automatized and automatized (supported by software system).
Rational Unified Process (RUP)	Methodology developed by the company Rational (at present, part of IBM) for the development of software systems. This methodology is based on the application of UML language for the specification of system architecture, utilization of use cases and iterative/incremental system design.

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Term	Definition
Report	Status of statistical unit provided by reporting unit within single collection. It contains cumulated statistical data.
Reporting (report or message)	It includes data of a single person – patient or insured person or HCP, ME.
Reporting unit	Person (natural person or legal person) (e.g. HCP, drug dealer, HCSA, Statistical Office of the SR etc.) or ME's employer. Only a person (natural person or legal person) can be obliged to reporting duty. RU is regulated by the following Acts: the Act No. 540/2001 Coll. on State Statistics and the Act No. 576/2004 Coll. on healthcare, services related to healthcare provision and on amending and supplementing certain acts.
Role (user's role)	Type of the software system user. Usually, it is equivalent to the working position in the organization. In the case the working position comprehends several different types of activities, multiple roles are being created. With the organization, one role can be assigned to more employees.
RU	Abbreviation for Reporting Unit
SAD	Abbreviation for Small Auxiliary Database. Database of health indicators which was part of procurement documents.
SD	Abbreviation for Special Department
Set of reporting units	Set of reporting units which are obliged to submit report/message within the respective collection.
SGML	Standard Generalized Markup Language
Specialized department	Part of medical facility providing specialized activity which is the object of statistical monitoring (e.g. ward, outpatients, workplace, etc.). The term has not its own legislative definition.
SR	Slovak Republic
SR-MH	Ministry of Health of the Slovak Republic
SSU	Abbreviation for Set of Statistical Units
Statistical Unit	Elementary unit, element of statistical survey
STN EN ISO	Slovak Technical Standard for the Quality Management System
SW	Software
SU	Abbreviation for Statistical Unit
Testing procedure	Sequence of steps to verify certain system functionality.
UML	Abbreviation for Unified Modeling Language
Unified Modeling Language	System of graphical languages for the specification of software systems from various perspectives. It is standardized by the OMG consortium and is applied de facto as an industrial standard for software graphic specification.
Use case	Sequence of activities exercised by system user and software system during system utilization by user.
Variable	Within this document, it has the meaning of the synonym to data entity item.
W3C	World Wide Web Consortium
WAFT	Framework developed by the company Softec for the development of web applications.
WHO	World Health Organization
XLS	Microsoft Excel File Format

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Term	Definition
XML	<p>Extensible Markup Language – standard of the W3C consortium representing simplification of the markup language SGML. Due to its extensibility, XML language is mainly applied for defining interfaces between software systems. Definition of parameters of flexible systems represents another common XML language application.</p>

2. Project goals

The goal of the “Development of *Health Indicator Information System*“ Project (“ISHI“ throughout the following text) was to create an information system to support the standardized process of solving requirements for new health indicators in the following stages:

- Development of the information system in phases: requirement analysis, system design, programming and internal testing in the provider’s environment.
- Implementation of the designed information system into the recipient’s environment (NHIC and SR-MH) and acceptance testing of the information system functionality in pilot operations in the recipients’ environment.
- Delivery of system and user documentation for the information system.
- Training of the administrators, operators and trainers of the information system.
- System handover.

2.1. Project inputs

- Tendering documents for a tender for the project [SP] defining system functionality requirements and system development stages.
- Harmonized set of health indicators resulting from the Twinning Light project containing indicators required by EUROSTAT as of the end of 2004 in an SAD database.
- HW configuration of the system’s computing environment in the recipient organizations NHIC and SR-MH (SUN Server, operating system Solaris, database system Oracle).
- Design of an information system of health indicators from the offer of company Softec [PON], the winner of the tender, specifying the system’s architecture.
- Service contract and (simultaneously) license agreement no. 200300499503-0601-0003 [ZML] for the development of a health indicators information system.

2.2. Contracting parties to project

Recipients

- Slovak Health Ministry (SR-MH),
- National Health Information Center (NHIC) – focused to ensure the execution of health informatics and statistics in the SR-MH sector.

Customer

- Slovak Finance Ministry (SR-MF), Central Finance and Contracting Unit (CFCU).



Provider

- Softec s.r.o.

2.3. System functionality requirements

The tendering documents [SP] specified the following functionality requirements ISHI:

- Provision of all health indicators required by EUROSTAT:
 - Data entry.
 - Suitable data storage.
 - Outputs in compliance with EU requirements.
- Provision of several mechanisms to access the stored data and their individual analysis.
- Storage of information necessary for the calculation and methodological description of health indicators and access to them through a user interface.

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- Ensurance of data entry by importing them in standard formats CSV, XLS, XML based on dynamic defined interfaces.
- Ensurance of a web interface for data input from primary data providers via the Internet.
- Ensurance of output of health indicators in the form of:
 - Printed reports in a required form in the Slovak and English languages.
 - Data file export in dynamic defined interfaces.
 - Displaying indicators on user PCs in the NHIC and SR-MH.
- Provision of all user interface elements for preparing necessary inputs and outputs.
- The system must be installed in the NHIC and SR-MH, data must be replicated from the NHIC to the SR-MH.



2.4. System development requirements

The requirements for the system development specified in the tendering documents [SP] are as follows:

- The development must be made in accordance with a standard technique.
- The development must extensively use the UML formalism.
- The development must be completed within 6 months from the signing of the contract in the following stages:
 - Development of SW solution
 - Implementation and testing
 - Preparation of documentation
 - Training
 - Handover.

2.5. Administrative deliverables of the project



ID	Deliverable name	Content of deliverable
1	Inception report (document)	<p>A more detailed work schedule containing a list of operations and a detailed time schedule of the performance of the contract.</p> <p>Identification of potential risks, limitations, requirements and persons that SOFTEC intends to use in the contract performance.</p> <p>Conclusions of the analysis of the present state.</p> <p>Clearly defined functions of the proposed software application system for health indicators as defined in the Offer of company SOFTEC in the ISHI.</p> <p>A detailed proposal of schedule of performance of the contract with a detailed specification of solution stages, procedures, rules and methods to be used in the contract performance, with an accurate definition of the content and acceptance of processes for each product offered under the contract.</p>
2	Interim report (document)	<p>Important information on the progress of works during a finished stage, which will make it possible to check the performance of works scheduled in the inception report.</p> <p>Identification of major changes and problems which were encountered during the performance of the contract, and methods of solving them.</p> <p>Three interim reports were drawn up after the completion of 4 material stages of the project:</p> <ul style="list-style-type: none"> ▪ Interim report no. 1 after concurrent completion of two stages: Development of SW Solution and Creation of Documentation. ▪ Interim report no. 2 after completion of the Training stage. ▪ Interim report no. 3 after completion of the Implementation and Testing stage.
3	Final report (document)	<p>Implementation summary of the performance of the contract.</p> <p>Project's strengths and weaknesses.</p> <p>Effectiveness of the introduction and efficiency of the project.</p>

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ID	Deliverable name	Content of deliverable
		List of meetings and seminars. Critical study of major problems (also in the system operations) with recommendations on how to avoid similar problems.

2.6. Material deliverables of the project

ID	Deliverable name	Content of deliverable
4	Requirements analysis (document)	Reconsideration of requirements for the system, requirements for reporting to international institutions, identification and description of relevant processes, tools and data formats, information sources, information content, future system users together with their specific needs and capabilities, evaluation of available infrastructure and hardware environment.
5	Requirements analysis after amendment procedure (document)	Second version of the document with ID 4, approved by recipients after processing suggestions to the first version, was incorporated.
6	System design (document)	ISHI architecture design including a design of database replication between the NHIC and the SR-MH, creation of a data model including health indicators data and necessary metadata. Functional description, screen flows of web application, menu system of internal application, interface definition, determination of a testing set of indicators and its subset whose metadata will be entered by SOFTEC, meeting requirements from Requirements Analysis by the system's designed functionality and initial entering of metadata.
7	System design after amendment procedure (document)	Second version of the document with ID 6, approved by recipients, after incorporating suggestions to the first version.
8	Implementation and testing plan (document)	Time schedule of the installation of SW solution, database and entering of metadata. Testing scenarios, acceptance criteria for the SW solution, acceptance testing plan in pilot operations.
9	Training of administrators, analysts and officers	Training of all types of personnel including delivery of applicable documentation. The technical documentation will contain: <ul style="list-style-type: none"> ✓ architecture description, ✓ description of the conceptual and physical design of the system, ✓ description of database structure, ✓ description of metadata and the mechanism of using them, ✓ technical description of defined indicators and OLAP cubes. Administrator documentation will contain an instruction for system administration and instructions for entering further metadata into the system, new indicators, new entry forms and interfaces. The user documentation will contain a manual for the system users which will be available online while working with the application.
10	Handover of the contract performance object to customer.	In the presence of the customer and the recipients' project manager, SOFTEC carried out acceptance and check tests. During the handover of the deliverable under the contract, SOFTEC handed over to the recipient's project manager and the customer the results of SOFTEC's tests demonstrating that the requirements for the deliverable

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ID	Deliverable name	Content of deliverable
		under the contract were met.
11	Protocol handover of project solution (SW product + documentation)	<p>Developed SW solution on a material medium (CD) in two identical copies.</p> <p>The developed SW solution was supplied in a form which makes it possible to change the SW.</p> <p>Installation tools developed for the SW solution were part of the deliverable.</p> <p>System (operating) documentation in 2 identical printed copies and in 2 identical electronic copies for each partial documentation item.</p> <p>User (instruction) documentation in 2 identical printed copies and in 2 identical electronic copies for each partial documentation item.</p>



2.7. Other outputs from the project

During the project solution, other outputs were created as well:

- In the *SW Solution Development* stage, the provider created the **ISHI program solution** which is described in Part 4 *Solution description* based on the approved document *System Design* (material deliverable no. 6).
- In the *Creation of Documentation* stage, the provider created the **user and system documentation**.
- In the *Training* stage, a **computing environment** for training (database system, application server tomcat) was installed in the NHIC environment, and the created ISHI program solution and the created user documentation of the system were implemented into it. The **recipients' personnel was trained** depending on their assigned roles, and the user training was based on a data collection via an A19 survey form for the year 2004. The training attendance lists (material deliverable no. 9) are annexed to the Acceptance Protocol (material deliverable no. 10). The numbers of the recipients' trained employees by role are in the table below:



Role name	Number of trained employees
Data elements and indicators administrator	7
Code lists administrator	7
Metadata collection manager	9
Collection manager	9
Metadata register manager	5
Register manager	5
Output views administrator	8
Data import administrator	4
Analyst	15
Standard outputs administrator	6
Contact person	7
System administrator	6

- **Issues from the training courses** (incidents of a faulty behavior of the program solution or documentation and incentives for improvements in the case of a suggestion for improving the user's comfort or a way of solution different from the one approved in

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the approved document System Design) were recorded **into the issues tracking application ECHO** of the recipient. Incidents and major incentives for improvement were resolved by modifying or expanding the functionality of the **ISHI program solution and documentation** prior to launching the Implementation and Testing stage.

- In the *Implementation and Testing* stage – in the preparatory phase, the document *Implementation and Testing Plan* (material deliverable no. 8) was first drawn up and approved by both parties. In accordance with the plan, a **computing environment for pilot operations was reinstalled in the NHIC** and a new version of the **ISHI program solution** was installed into it after incorporating issues from the training courses. A **computing environment** was installed **in the SR-MH** for the first time and the ISHI program solution was implemented into it.
- The *pilot operations* were focused on using and testing the following basic procedures for working with ISHI for individual user roles:
 - Requirement for a new survey
 - Requirement for an output of a new indicator
 - Requirement for storing a new type of data in administrative registers
 - Accessing of web application for RU
 - Entry of RU statements into web application
 - Implementation of survey by data collection for one year
 - Register update
 - Data analysis of output views in MS Excel
 - Creation of reports from data of output views in MS Access
 - Registration of a new user
 - Change in the frequency of calculating output views
 - Installation of an Oracle client and ODBS on a client PC
 - Installation of a new version of ISHI (exe, war, db)
 - Database backup (by export)
 - Database restoration from a database backup (by import)
 - Data replication from the NHIC to SR-MH.
- For the pilot operations, the provider **initiated administrative registers** from data supplied from the NHIC, as well as **metadata and data from statistical survey on L1 forms** (with more than one thousand items in the form) and **Z1 forms** (with more than one million filled forms delivered per year) by a collection for the year 2004. To ensure a practical result of the pilot operations, in the pilot operations the recipients' users entered metadata as well as data from a real statistical **survey via an A3 form** obtained by collection for the year 2005. More than 12 planned meetings of the recipients and the providers were held during the pilot operations. In addition to verifying data already entered, the meetings served to discuss the techniques used and to expand the users' orientation in the metadata layers and the functionality of the ISHI being provided and suitable procedures for using it.
- During the pilot operations, issues were recorded in the Internet issues tracking application ECHO either as an incident (in the sense of a **defect**, if the gravity was

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higher *lower*) or an incentive for improvement (not a defect). Before the acceptance testing of the ISHI program solution, a **new version of the ISHI program solution and user documentation** was installed in the recipients' environment after removing all recorded defects.

3. Project execution

3.1. Project objectives

The set objectives of the project were fulfilled with the following changes:

- In the *Analysis* phase of the *SW Development* stage, **new requirements for the system's functions** were recognized:
 - Provision of a basic user interface for updating **administrative registers** (*Register of Health Care Providers, Register of Medical Staff*) whose management is necessary to determine reporting duties for individual statistical surveys.
 - Provision of the administration of a **Data Element Catalogue** of health statistics as a standardization tool to describe collected data and computed indicators.
 - Possibility of the collection and processing of **reports**, in addition to the collection and processing of data of **statistical statements**. Reports do not have a statistical character because they report the occurrence of monitored diseases or admissions to a hospital on an individual basis for a single patient. The report collection and processing is very similar to the statistical statements collection and processing.
- The project **solution time** was 7 months (in accordance with the application for contract amendment [ZML-1]). The reason was a delayed administrative start of the project and the need of successive execution of the *SW Development* and *Implementation and Testing* stages.
- After the completion of the project, the project's **final seminar** was held with a public presentation of the project results.



During the project execution, the recipients' authorized personnel cooperated with the provider's team in an atmosphere of mutual trust and joint effort aimed at creating a high-quality product.

3.2. Project evaluation

The Information System of Health Indicators with which the NHIC receives a **production line** for the preparation of statistical surveys, statements (reports) collection and their subsequent processing aimed at obtaining output health indicators for the needs of the centre, SR-MH and foreign institutions, clearly is a **revolutionary leap** from separate disconnected data collection and processing for individual surveys to a standardized, automated and fully interconnected data collection and processing for all statistical surveys.

3.2.1. Project strengths

The system brings a **unified collection method** for all surveys with the storage of collected data in a **single database** which, together with a description of metadata collection layers, becomes a **joint data source for the outputs of all indicators**. This is the biggest gain of the project as it allows abandoning the current practice of collecting data separately for individual

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surveys on PCs of individual collection managers without connections to the same surveys for previous years and other surveys.



Other undeniable benefits result from the implemented **metadata layer** principle:

- The system operators are **prepared for legislative changes** in the area of health statistics and registration of reporting units and other health-statistics entities – they can be included in a survey by a simple change in metadata.
- In the event of legislative changes, the system operators are **independent from the provider**, as the system's program solution need not be changed, just metadata must be modified.
- Partial changes against previous years' surveys can be made without severing continuity with data collected in previous years.
- **Data time series of individual indicators** can be created despite year-on-year changes in individual surveys.
- The system also allows monitoring all surveyed data through a **data element catalogue** as well as all computed indicators through an **indicator list**.
- The system supports the use of **basic code lists** in all surveys and outputs, thereby allowing a **data interconnection between individual surveys**. The metadata collection administrators may decide in their own discretion whether they will use the basic code lists for individual surveys and will make the restriction of code-list items necessary for the given survey by the code-list's **classification dimension** provided by the system. It allows the managers to abandon the current practice of creating new code lists by copying a subset of items of basic code lists, which made it impossible to interconnect data from individual surveys.
- The system allows the **reporting units** with access to the Internet to fulfill their reporting duties by **entering statement data in a web form**, where the statement data will be recorded directly into the system's database just as if they were re-written from a paper form by an NHIC employee.
- The system allows addressing **the reporting units** in a uniform manner for all types of surveys. The determination of the reporting duty depends on the structure and content of **administrative registers** and therefore the metadata structure on the metadata level must be correctly designed and properly filled in. This will prevent contact persons of individual surveys from independently and repeatedly asking the reporting units whether or not they are subject to the reporting duty for individual surveys.
- Collection and output metadata make up a **documentation of individual surveys**, and their content by and large corresponds to the content of **technical reports** by which the individual surveys were designed (as a task for programmers) and documented. The system can be expanded by adding a function for technical report generation for individual surveys.

3.2.2. Project weaknesses

The project's weaknesses comprise:

- Functionality of the management of administrative registers
- Reserved approach of some metadata administrators
- System replication in the SR-MH.

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Functionality of management of administrative registers

The management of administrative registers was lacking in the requirements for the system. This requirement of the NHIC was recognized as an urgent one in the requirements analysis phase because of the necessity to determine the reporting duty for statistical surveys and for other reasons. Therefore the provider accepted the expansion of the system's functionality by adding the management of administrative registers and designed a solution of the management of administrative registers based on a metadata principle similar to that designed for statistical data survey collection and calculation of output views together with indicators from them because of repeated legislative changes anticipated in this area. To compensate for the functionality expansion additional to the original project, it was agreed to provide just the basic functionality for the metadata management.

For an effective use by the users, this basic metadata management functionality must be expanded as described below:



- To make the creation and update of participants, roles and relations (as has already been proposed in the form of incentives for solutions in the Internet issues tracking application ECHO) more user friendly.
- After fixing the structure of the administrative registers, specific customized screens must be provided to NHIC users and possibly to personnel of external organizations where the data for the administrative registers are created. The custom-made screens will be used for entering and updating a certain extent of data (e.g. for recording permits to operate a medical facility issued to external users by the issuer - the regional government and by internal NHIC users for recording pre-existing permits).
- After fixing the structure of the administrative registers, functions should be added for importing data of a determined subset from external suppliers where data are created and updated (e.g. data on physicians from the chambers of physicians).

Reserved approach of some metadata administrators

NHIC personnel participated in the requirements analysis and system design in the SW Development stage. Thereby the NHIC personnel got a realistic notion of the designed structure and purpose of metadata layers.

The other metadata managers first got to know the system's functionality, the way of how the new system will change the presently used working procedures of the users (notably metadata administrators) and individual metadata layers during the training courses. Because of the operations carried out by them and routinely used procedures, most of the metadata administrators had had an idea of the new system. We may surely say that thanks to its metadata-layer concept the newly created system surpassed the expected limits of metadata control as well as anticipated limits of the involvement of the metadata administrators in the metadata creation. The biggest problem was to overcome the previous normal practice when the metadata administrator in a new system as if "programs" data collection and processing by inputting certain metadata layers – i.e. the administrator carries out operations that were previously performed by programmers by creating a specific program for individual surveys and their annual collections.

On top of that, the work with the new system creates a new effect: all entered code lists, data elements, record types and their items are accessible for use not only to their authors but also to the other metadata administrators.

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System replication in the SR-MH

In using the system, the SR-MH users are in a passive position of consumers of data created by the NHIC users in the NHIC computing environment. It is expected that external-views data together with health indicator data will be used for analysis by SR-MH analysts and possibly for creating standard reports in MS Access by SR-MH standard outputs administrators.

If the creation of own external output views is required, then the output views administrators must become remote users of the active part of the system in the SR-MH environment. The result of their work will then be transferred to the SR-MH by the next data replication from the NHIC to the SR-MH and will be made available to the other users.

From the point of view of the currently known technologies for a safe remote access, it is not necessary to place such a passive replica to the SR-MH system, as the SR-MH users only need a safe remote access to the NHIC system.



3.2.3. Recommendations for system operations

Recommendations for the system's commissioning stage

- To decide about the structure of the administrative registers and a reliable data source for filling them initially.
- To ensure an initial filling of the administrative registers.
- To secure a more user friendly expansion of functionality of the management of the administrative registers allowing so a more efficient updating.
- To ensure the rules for filling metadata (to use only basic code lists, not to create a new code list by copying a subset of items from an existing code list, how to create the codes and names of the code lists, code-list items, data elements, indicators, record types and record items, how to number record items, etc.).
- To authorize the more experienced metadata administrators to supervise the work of the less experienced ones.
- To decide from which year onwards the surveys will be processed in the system and to compile a plan to transfer the surveys into the system.
- To review the content and form of each survey being processed in the ISHI and to determine the collection metadata.
- To support a legislation change that will determine a single manager of a given register with the scope and structure of data necessary for all customers.
- To allow the reporting units to send in their statistical statements via a web form from the NHIC website.
- To ensure that the reporting units are notified about the possibility to send in their statistical statements via the web form of the ISHI application.

Recommendations for routine operations

- To secure data sources for continuous updates of data in the administrative registers.
- After a legislative decision is made about the managers of registers which are part of administrative registers, to allow register data updates by the data originators via specialized web interfaces.

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- To ensure a continuous optimizing of ISHI functionality.

3.3. Critical study of major problems

During the SW solution development, training courses and pilot operations, the providers or the recipients identified the following serious problems, in addition to the problems described in Part 3.2.2 *Project weaknesses*:

- short time of project execution,
- imperfect legislation.

3.3.1. Short time of project execution

The **project execution time was extremely short. 7 calendar months** (6 months before an amendment to the contract [ZML-1]) were allocated for all phases and stages comprising the requirement analysis, system design, project implementation and internal testing, training, implementation into the recipients' environment and testing in pilot operations as well as handover of the deliverable under the contract.

Therefore the development of the solution from the SW Solution Development stage onwards was a **single-transition one, without planned functionality increments and iterations** of their development as is a standard procedure in the development of more extensive SW solutions. In this case it is undoubtedly a complex system based on metadata layers in which a change in the metadata structure necessarily results in the need to change the functionality controlled by the metadata.

In the *Implementation and Testing* stage, the providers' designers carried out an informal (unscheduled) **iteration of an improvement of the SW solution's functionality** based on the users' requirements from the *Training and Implementation and Testing* stages.



The project did not include a planned so-called **start-up stage of the system** without which the system cannot be used for statistical data collection and processing in routine operations. In this stage it is necessary:

- to define a suitable structure of the administrative registers and to initially fill them with data from available sources,
- to review all statistical surveys made in the NHIC, first for the methodology and then for the content, and then to start defining metadata for the collection and calculation of output views for health indicators.

Moreover, according to the project, the launch of the solution stage was conditional on the approval of the interim report of the preceding completed stage, which actually cut short the time available for solving the material stages.

3.3.2. Imperfect legislation

The tendering documentation [SP] for the tender for the *Development of an Information System of Health Indicators* did not require the management of a health insurance entities register (called **administrative registers**) which would allow registering health insurance entities in the minimum extent which makes it possible to determine their reporting duty for individual statistical surveys. The requirement to additionally develop a basic functionality for the management of administrative registers was added during the *Requirement Analysis* phase of the *SW Solution Development* stage.

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The administrative registers include the Central Register of Health Care Providers (CRHCP), Register of Other Entities of Health Statistics (e.g. NHIC), Central Register of Medical Staff (CRMS: physicians, pharmacists, nurses, ...) as well as all types of licenses authorizing a natural or legal person to be a health care provider, medical worker, etc.

By law, the administrative registers are maintained by the SR-MH, on behalf of which the registers are maintained by the NHIC, based on various types of permits specified in legislation and issued by various bodies of state administration, local government or professional organizations. However, also other organizations are authorized to maintain some registers – e.g. the Health Care Surveillance Authority maintains an HCP Register and issues HCP codes and physician’s codes. Unfortunately, because of the current legislation, the register’s data composition and structure is different from that of permits which are the data source for the administrative registers in the NHIC.

In the pilot operations, the administrative registers were filled with data valid as of the end of 2004. Their structure and obsolescence are not acceptable for the routine operations from 2007 onwards. As early as during the pilot operations, the administrative register data turned out to be obsolete and their data structure insufficient for determining the reporting duty in 2005.



Therefore in the start-up stage the NHIC must solve the problem of the **administrative register data structure** and verified data sources for their initial filling.

The ultimate goal should be to pass a legislation which appoints a **single manager of the administrative registers** with their data structure sufficient for all recipients.

3.4. List of meetings and seminars

The meetings and seminars held during the project execution are listed below:

No.	Content of the meeting / seminar	Date
0	Administrative opening of the project, appointment of project managers and project leaders on the part of the recipients and the provider	1.12.2005
1	More detailed specification of requirements defined in the offer, detailing of the intended method of solving the requirements, plan of further steps	7.12.2005
2	Data model, data warehouse, data collection process, input checks of data	9.12.2005
3	More detailed specification of the importance of components of provided data Model 1, procurement of information on input statements and reports, their further processing, procurement of information on input checks, plan of further progress	14.12.2005
4	Detailing of obtained information on checks, description of the process of transformation of input data into output indicators, plan of further progress	16.12.2005
5	Detailing of obtained information on inputs, outputs and processes in ongoing data processing. Making an agreement on testing and acceptance conditions. Plan of further progress.	21.12.2005
6	Detailing of the sequence of handover and approval of output documents. Supplying of additional information from NHIC and making an agreement on the conditions of execution. Plan of further progress	3.1.2006
7	Presentation of document Requirement Analysis	11.1.2006
9	Verification set of health indicators	17.1.2006



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No.	Content of the meeting / seminar	Date
9	Presentation of proposed data model of ISHI application and discussion	18.1.2006
10	Statement statuses, collection statuses	20.1.2006
11	Presentation of document System Design	2.2.2006
12	Class mapping of Model 1 (author NHIC) on Administrative Registers (author SOFTEC).	6.2.2006
13	Continued discussion about document System Design - Version 1.0	9.2.2006
14	Data identification for administrative registers and their description.	14.2.2006
15	Proposal of code lists for standardization in the health sector.	16.3.2006
16	Mutual explanation of understanding and definition of data elements, detailing of structure of administrative registers and elimination of unclear points relating to filling the registers.	12.4.2006
17	Making an agreement on the content and progress of pilot operations	26.-29.5.2006
18	Support to the recipients' personnel during pilot operations in NHIC conference room during pilot operations	5.-30.6.2006
19	Meeting with NHIC director about progress in handover of deliverable under the contract after completing the pilot operations.	23.6.2006
20	Preparatory meeting of administrative project managers about organizational aspects of the project's final seminar in SR-MH.	26.-29.5.2006
21	Meeting aimed at ISHI acceptance testing.	5.7.2006
22	Meeting aimed at handing over the deliverable under the contract on ISHI Development project.	11.7.2006
23	Final seminar on project Strengthening of Statistical Health Information System and Its Harmonization with EU Requirements, with presentation of ISHI Development project opened to the public and the media.	14.7.2006

3.5. Financial report

The ISHI Project was solved for a global price under the contract. The money was spent on the following activities:

- solution of the contract's stages SW Solution Development, Documentation Creation, Training, Implementation and Testing, Handover,
- administrative control of the project and information about the status of project execution in the form of reports: inception report, interim report no. 1 on progress in SW solution development and documentation creation, interim report no. 2 on trainings, interim report no. 3 after implementation and testing, final report, translation of reports into English,
- purchase of a development server from the same supplier and with same operation system as is in the target environment for ISHI, and training of administrator of development server,
- participation in making the project's final seminar.

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No subcontracted works were performed under a contract during the project execution. The graphic design of the Internet part of the system was prepared by agency Pragma, Bratislava under an order in the amount of SKK 74,460 excl. VAT.

4. Solution description

4.1. Basic system-supported processes

The ISHI system is designed as an automated “production line” which supports all basic steps in the processes of survey preparation, data collection, and processing of the results of statistical surveys made by the NHIC.

4.1.1. Proposal and preparation of survey

The preparation of a new statistical survey starts with a methodology definition. The methodology is defined outside the ISHI system and is its principal input.

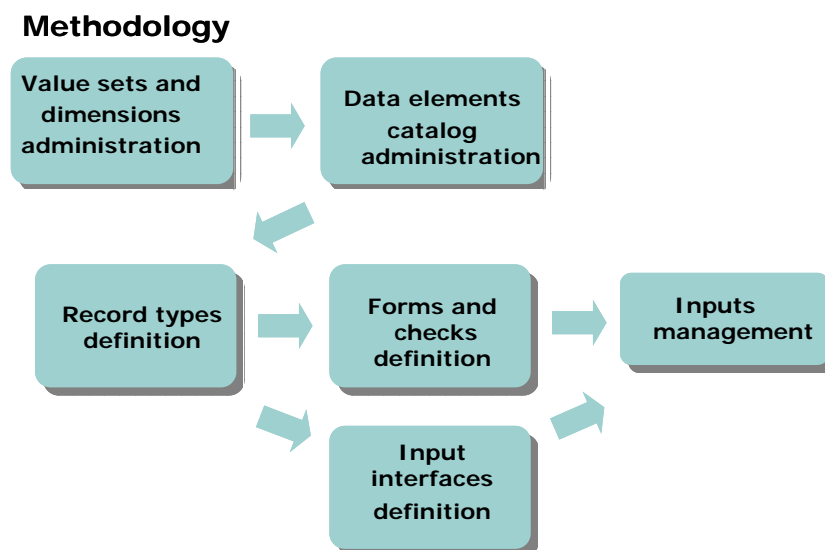


Fig. 1. Preparation process of a new survey

As part of the preparation of a new survey, necessary code lists, dimensions and data elements are defined based on the defined methodology. They serve as a basis for defining the record type corresponding to the given survey, whose items determine the content of the survey, and the appearance of the forms, including checks of input data.

The system supports data inputs and outputs via various interfaces (web form, XML, XLS and CSV files).

The input management makes it possible to keep track of the frequency and delivery date of statistical statements for individual surveys.

The specific content of these processes is explained in more detail in the part on the system’s metadata structure.

4.1.2. Data collection

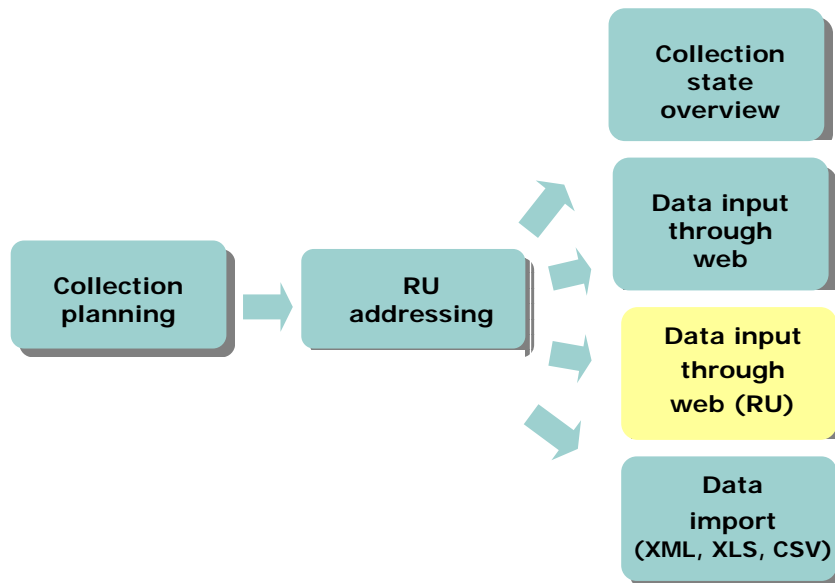


Fig. 2. Data collection process

The data collection starts with the definition of selection criteria for a set of reporting units which must report the data of a given type. Based on defined criteria, the system allows to generate an addressing either in the form of a text document (Word), sent by classical post or e-mail. Those reporting units that have access to the Internet may complete a statement form via a web interface. If the data are supplied electronically in defined interfaces, the system allows their import. The data from a statement sent in by a reporting unit on a paper form can be entered into the system by the NHIC personnel via a web interface. In the process, the collection administrator is always kept informed about the collection status and the number of expected and received statements.

4.1.3. Data processing and output

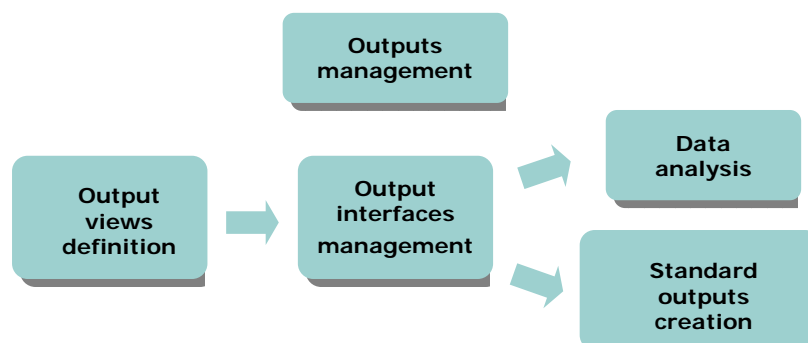


Fig. 3. Process of data processing and output

The ISHI system is based on the principle of a content separated from the form, therefore the data processing is defined by means of the creation of output tables (de facto aggregate views of input data). These can be exported via defined output interfaces. From the output data, standard printed outputs are created and used in various analyses.

4.1.4. Register management

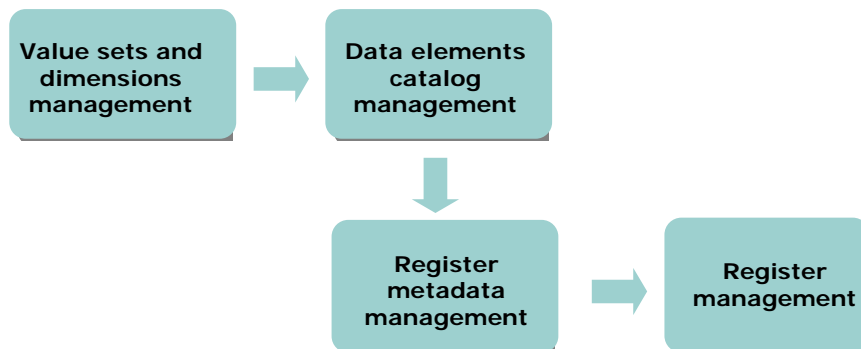


Fig. 4. Register management

The register sub-system is also controlled by metadata, and therefore further registers can be added to the system or their structure can be updated. The register metadata also use code lists, dimensions and a data element catalogue.

4.1.5. ISHI system architecture

Logical architecture

It is shown on the chart below.

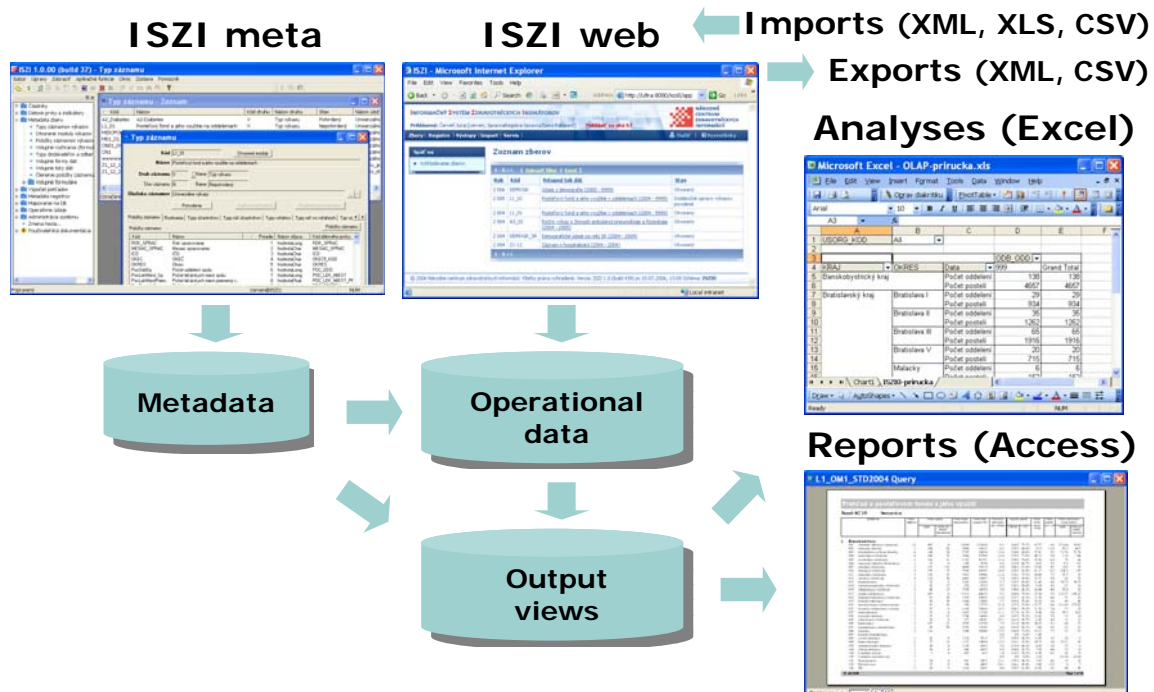


Fig. 5. The system's logical architecture

The basis of the ISHI system is **metadata**. The metadata are managed by a client-server application ISHI meta which is created in language C++ and uses the company's own framework FFAST. Although this technology requires the installation of a client application on

user computers, it is not a problem as the number of metadata administrators is much smaller than the number of users working with operational data.

Operational data, i.e. own data that are subject to a statistical survey are managed by means of the web application ISHI web which is created in the Java language and uses the company's own framework WAFT. The application is controlled by metadata which are defined by means of the ISHI meta application. The behavior of the web application can therefore be modified by a metadata modification without the need to change the program code of the web application.

The ISHI application is also used to define output tables as the process of transforming inputs into outputs is defined by the metadata.

Standard printed outputs are made with the tool MS Access and analyses are made in MS Excel because the NHIC and the SR-MH have these tools and trained personnel that can use them. The system architecture allows a trouble-free use of MIS tools for analysis.

Physical architecture

The distribution of the system's components is shown in the picture below.

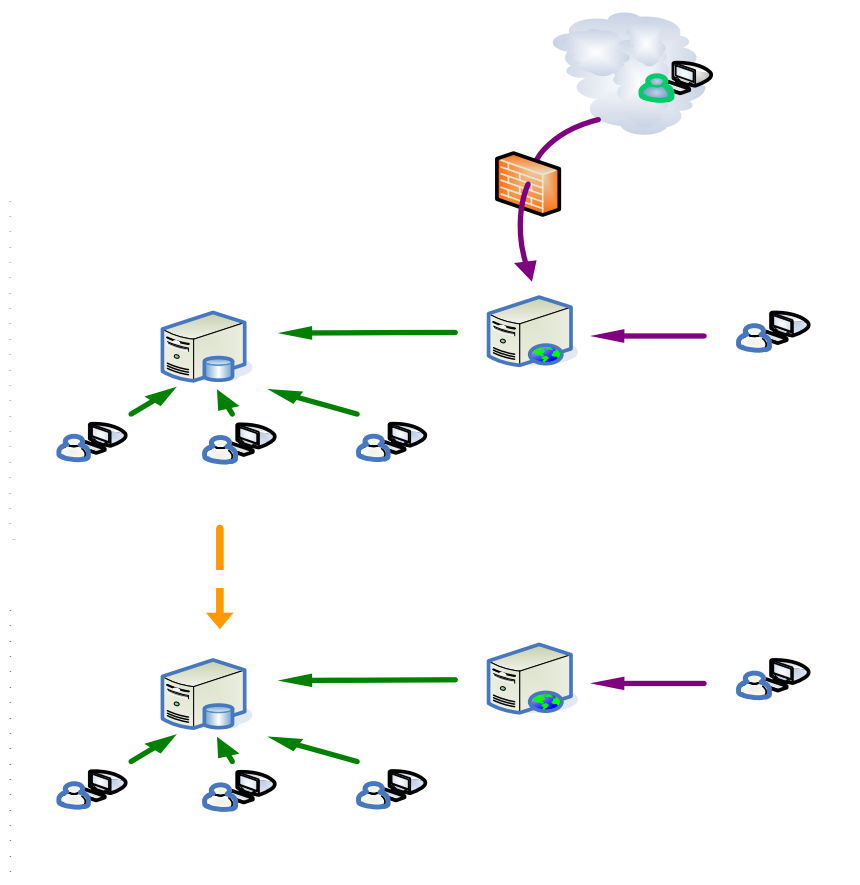


Fig. 6. The system's physical architecture

The only institution which is expected to actively work in the area of metadata specification and data collection is the NHIC. Both NHIC and SR-MH are expected to actively work with the data from output views. They can be analyzed in MS Excel, and datasheets can be created from them in MS Access or data in the administrative registers can be viewed. The data from the SR-MH database will be replicated to the NHIC database on a regular basis.

4.1.6. Structure and management of system metadata

Basic metadata

Statistical surveys typically are multi-dimensional in nature, as the majority of the surveyed indices (or indicators) are classified by various criteria (dimensions), such as territory, age, sex, diagnosis code, period, etc. These classifications mostly have a multi-level hierarchical structure. Therefore the ISHI system supports dimension definitions as a hierarchical structure of associated code lists (e.g. the territory dimension consists of the code lists of municipalities, districts, regions and areas). The system actively uses such hierarchies for creating outputs with a classification less detailed than that of the input data.

The basis of the metadata therefore are **Code Lists** and **Dimensions** (hierarchical structures of code lists). The system allows to very simply defining the hierarchic relations of code lists.



Fig. 7. Example of grouping regions into areas

To keep track of the content of registered and surveyed data, the requirements for the system include also the requirement to create and manage a **data element catalogue**. The system distinguishes between three types of data elements:

- sorting (district, diagnosis, specialization code, company registration number, etc.) – they largely contain code-list codes,
- numerical – they contain the subject of the survey, the data are obtained in various details, sorted by various classification elements,
- descriptive - they contain more detailed text descriptions of sorting elements (e.g. a Slovak or English description of a code-list item).

Record types are defined for each survey in the system. They contain a description of the structure of input statistical statements and output tables.

Record items – they express the meaning of the data. They are associated with data elements (e.g. the number of in-patients) and more detailed specified in accord with some list codes (e.g. the number of in-patients with diagnosis XXX, men, aged 20 to 29 years, etc.).

Output numerical items of records can be defined as indicators. That means that additional descriptive details and classifiers by various criteria have been added on them.

Input metadata

For input-type records input data flows are defined, i.e. determination from whom and how often we expect the data. Accepted data forms are defined too (WEB, XLS, XML, CSV).

Input metadata are based on a description of input forms. This description is separate from the record type description to ensure a better separation between the form and the content.

Content description – record type - is more stable in time and therefore makes it possible to construct time sequences over several years.

Form description - input form – may change from one year to another. It has a so-called module structure. A module is part of a form containing a group of logically related data items. It commonly has the form of a 1- or 2-dimensional table.

2304. modul	Osoby so zvýšeným rizikom ochorenia	I. r.	Počet osôb		Kontrolný súčet (stl. 1 a 2)
			spolu	z toho deti	
		a	1	2	99
R1	všetky rizikové skupiny	01			0
	z toho s chemoprofylaxiou	02			0
R2	kontakty	03			0
	z toho s chemoprofylaxiou	04			0
Kontrolný súčet (r. 01 až 04)		99	0	0	0

Fig. 8. Example of a module from A3 statement (annual statement of activities of pneumological and ftizeological outpatient departments)

Checks are defined for the forms. The checks ensure that the data are logically consistent (e.g. the data in the “z tohto detí” („from which children“) column cannot exceed the data in the “spolu” (“total“) column. These checks are automatically launched by the web application when filling in a given form. In performing the checks, the metadata use a special check language which makes it possible to directly re-write the checks defined in the methodology.

Output metadata

Data flows are defined for output-type records similarly to the input-type records. They specify to whom and how frequently the data should be supplied.

Output tables define the constructing of output (mostly aggregate) data – indicators.

Metadata for defining a processing algorithm are so-called folders of calculation definition. They define the procedure to calculate the output from the input without need of programming. To simplify the definition of metadata, they are automatically generated by a wizard. The generated metadata can naturally be modified manually thereby modifying the prescribed calculation technique.

Code-list items of output-type records in an **indicator list** can be expanded by further classifications important for health statistics.

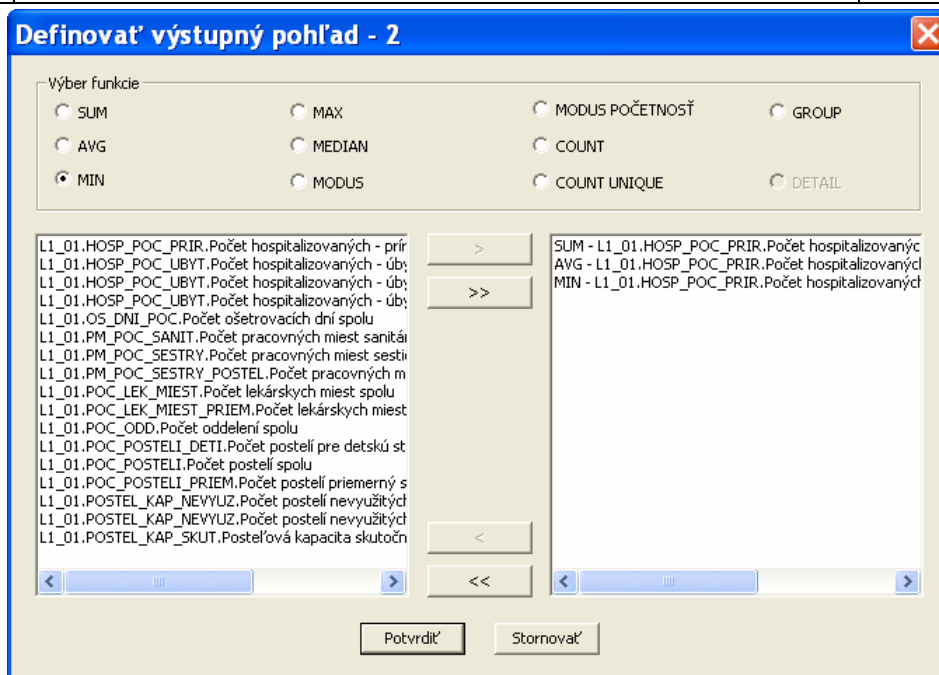


Fig. 9. Example of output table (view) definition

Register metadata

Into the ISHI system is also a HCP (health care providers) register included. The data from the register are the basis for selecting a set of reporting units for surveys. If identification data in a received statement are consistent with data in the register, the system will automatically associate the received statistical statement with the reporting unit concerned, which will make it possible to add into outputs not only the data from the statistical statement but also corresponding details of the respective provider.

The structure of the metadata registers uses M. Fowler's analytical pattern "Responsibility" [1], modified by Ľ. Šešera [2]. This will allow to add further registers into the system in the future or to modify their structure in order to bring them in line with legislative changes without the need to make changes in the application code.

4.1.7. Processing of operational data

The ISHI web application has been created for processing operational data. The application's functionality is controlled by metadata.

The application allows the NHIC personnel to accomplish a **collections management** for surveys defined by input metadata.

It also allows addressing the reporting units having reporting duty to a set of collections. Statistical statement data for each collection can be entered on a web form or by data import in defined formats, incorrectly filled-in statements can be corrected on a web form, the collection status can be monitored, undelivered statistical statements can be identified, collection can be terminated and reopened for additional corrections.

The application allows a reporting unit covered by reporting duty to enter and to correct statistical statement data, and to view already entered and confirmed statistical statements.



The following table gives an example of one module of a web form of a statistical statement. It also illustrates the manner of highlighting an incorrect data revealed by a check.

Neúspešne vykonané kontroly

	206	2304. modul -R01 musí byť väčší alebo rovný R02 pre S2
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Modul: 2304 - Osoby so zvýšeným rizikom ochorenia			
		Počet osôb	
		spolu	z toho deti
		1	2
R1	všetky rizikové skupiny	1	<input type="text" value="185"/> <input style="border: 2px solid red; text-decoration: underline wavy;" type="text" value="2"/>
	z toho s chemoprofylaxiou	2	<input type="text" value="59"/> <input type="text" value="8"/>
R2	kontakty	3	<input type="text" value="196"/> <input type="text" value="112"/>
	z toho s chemoprofylaxiou	4	<input type="text"/> <input type="text"/>

Fig. 10. Example of part of an input web form with a highlighted error

	<p style="text-align: center;">FINAL REPORT</p> <p style="text-align: center;">Strengthening of Statistics Health Information System and its Harmonization with EU Requirements</p> <p style="text-align: center;">Information System of Health Indicators</p> <p style="text-align: center;">Contract No. 200300499503-0601-0003</p>	
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