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# List of symbols and abbreviations

DBMS – database management system;

HEI – higher education institution;

SAS – software audit system;

SPE – scientific and pedagogical worker;

UML – Unified Modeling Language.

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[**http://blogs.kpi.kharkov.ua/v2/metodotdel/wp-content/uploads/sites/28/2022/12/STZVO-HPI-3.01-2021-SSONP.-Tekstovi-dokumenti-u-sferi-navchalnogo-protsesu.-Zagalni-vimogi-do-vikonannya-zi-zminami.pdf**](http://blogs.kpi.kharkov.ua/v2/metodotdel/wp-content/uploads/sites/28/2022/12/STZVO-HPI-3.01-2021-SSONP.-Tekstovi-dokumenti-u-sferi-navchalnogo-protsesu.-Zagalni-vimogi-do-vikonannya-zi-zminami.pdf)

5.4.4 The following order is established for letter marks: first, the marks in the Ukrainian (Russian) alphabet, then in the Latin alphabet, and lastly in the Greek alphabet.

5.4.5 Regardless of the presence of a list, the first appearance of symbols (abbreviations) in the text should be followed by their decoding.

# Introduction

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5.5 Introduction

5.5.1 The introduction should provide a brief description of the current state of the scientific (technical) problem (issue) to which the paper is devoted, and emphasize the relevance and novelty of the topic under development. Historical references, descriptions of previously published works, and well-known provisions are not included in the introduction.

5.5.2 The introduction should not exceed three pages. The text of the introduction is not divided into paragraphs. The introduction cannot contain figures, tables, etc..

It is recommended to set out in the following sequence:

1. relevance of the topic of the work;
2. problematic issues on the topic that need to be addressed;
3. directions for solving problematic issues;
4. the purpose of the work;
5. object and subject of research;
6. work task and stages of its implementation.

It is advisable to present the introduction in such a way that it becomes the beginning of the student's speech at the defense.

# 1 Topic 1

## 1.1 Option for presenting section 1

Section titles should be as specific as possible, but use no more than 10-12 words

1.1 Analyze the business processes (in other words, the specifics of the organization for which the software is being developed (= the automation object selected for the course project). After the analysis, be sure to analyze the shortcomings inherent in the current implementation of business processes in the organization.

1.2 Developing proposals for improving existing business processes. Building a BPMN business process model, taking into account that some operations will be performed using the developed software.

1.3. Developing a software requirements specification (or statement of work) (see ISO/IEC/IEEE 29148 or other approaches to technical task representation).

1.3.1 Development of a general description of the software application:

* name;
* purpose;
* software users.

1.3.2 Developing a system of requirements for application software

Present detailed functional and non-functional requirements for the software solution (it is recommended to follow the definitions and classification of requirements according to the book by K. Wiegers). The requirements can be presented in the form of a list of necessary items or in a table. You can use a requirements diagram to represent functional and non-functional requirements. Functional requirements can also be represented as a UML use case diagram.

1.3.3 Determining the sequence of software development:

* composition of the development team;
* approximate development period;
* development stages and participants;
* list of artifacts and documents to be sent to the customer.

## 1.2 An alternative version of topic 1.

1.1. Analysis of business processes (BP) (in other words, the specifics of the organization for which the software is being developed). Building a business process model in the "AS-IS" version, i.e. a business process model in the current state.

1.2. Analyzing the shortcomings of the existing BP, formulating proposals for improvement, and building a model of the BP in the "SHOULD-BE" version.

Further 1.3. similar to the above option.

It is advisable to develop a clause that analyzes various ways to overcome the identified shortcomings of the BP, the so-called review of analogues. It can be combined with an analysis of the shortcomings of the implementation of the BP.

# 2 Topic 2

In sections two and three, it is proposed to present the results of detailed software design, justification of technical solutions and selection of a technology stack for development, as well as the principles of software testing both during creation and at the stage of assembly into a finished solution. The results of this section should include a set of UML diagrams and a database structure that allows for the creation and testing of software. To justify the choice of technology stack and DBMS format for data storage, it is advisable to provide tables and graphs that reflect the data of the research. It should be noted that a reasonable choice involves the analysis of two or more possible options according to various criteria arising from the requirements for the program. If such an analysis is not performed in the work (for example, the technology stack has already been determined by the team or it is determined by the technology used for components already existing in the system), then a DESCRIPTION of the technology stack should be presented, indicating the features of the application, the existing advantages and disadvantages.

It should be noted that this section may contain a large amount of material that can be included in appendices.

# 3 Topic3

A option of the sections structure based on work with topic «Design and development of software for the department's software audit system».

Module 1. Justification of the need to automate the accounting of the department software

1.1 Analysis of the current state of organization of accounting of the department's software

*It involves analyzing the existing state of business processes with a detailed description and building a model of audience distribution planning processes, which uses information about computers and installed software, using BPMN.*

*It is also planned to develop a domain model and a glossary.*

1.2 Analysis of modern software audit systems with the development of proposals for implementation at the department

*It provides a description of the current requirements of users who are interested in information about the equipment of computers in classrooms, proposes changes to the accounting system, and develops a modified process model using BPMN.*

1.3 Developing a system of requirements for a software audit system

1.3.1 Description of the purpose of the system

1.3.2 Determination of functional and non-functional requirements for the software being developed

1.3.3 Description of the stages of software development

2 Software design

2.1 Development of behavioral diagrams

2.1.1 Development of diagrams of use cases for different categories of users

2.1.2 Clarifying the implementation of use cases with the development of interaction diagrams

2.2 Development of a database for storing information

2.2.1 Defining the business rules of the subject area

2.2.2 Development of the database structure

3 Reasoned choice of technology stack for system creation

3.1 Choice of system architecture

3.2 Selection of the database management system format

3.3 Description of the programming language and technologies for creating systems

3.4 Definition of software development tools

3.5 Identifying components and developing a deployment diagram

# 4 Topic 4

Deployment and applaying developed software

2 Description of software deployment

In this point, it is proposed to present:

* information about the installation package for software deployment depending on its architecture;
* a software deployment diagram to determine hardware and system software requirements.

3 Description of the interface and the order of application of the software

The process of using the created software is presented in an arbitrary form. When setting out the description, it is advisable to focus on the Use view Case diagrams. It is also advisable to provide information about the peculiarities of entering data and commands on various pages (forms, screens) of the interface.

At the end of the report, present a list of sources of information that were used in the preparation of the report.

At the beginning of the report, title pages and abstracts should be presented, the form of which is determined by the head of the practice.

# Conclusions

The conclusions should contain the following elements:

* a reminder of the task that was solved and the goal for which the work was performed;
* the main results obtained during course project preparation;
* conclusions (at least three) that can be drawn from the standpoint of software engineering issues that can be made based on the results of software development;
* practical value of the obtained results;
* possible areas for improvement (continuation) of development or research (optional).

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5.7 Conclusions

5.7.1 The conclusions should provide a summary of the results of the work performed and proposals for its use, as well as an assessment of the technical and economic efficiency of the work result and its implementation.

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Requirements СТЗВО-ХПІ-3.01-2021

5.8.1 A list of information sources (LIS) is a list of cited, referred to and used information sources (IS). The sources of information are: books, articles, normative and technical documents (NTDs), research reports, dissertations, technical and economic standards and norms, price lists, abstracts and reviews published as separate documents.

5.8.2 The list of references includes the sources of information referenced in the text \*.

5.8.3 In the list of references, bibliographic descriptions of sources of information are arranged in the order in which the sources are first mentioned in the text. The sequence numbers of the descriptions in the list of references are the numbers of references to them. An example of a list of references is given in Appendix A. \* References are made in accordance with 6.3.10.4.

5.8.4 Bibliographic descriptions of information sources are given in the form in which they are presented in the information source (on the title page, the back of the title page, and other elements of the document containing the original and similar information), taking into account the requirements of ДСТУ ГОСТ 7.1.

Requirements СТЗВО-ХПІ-3.01-2021.

**An example of a list of reference sources**

REFERENCE LIST

1 Державна система сертифікації України. Методи, правила, організація діяльності : довідник / Ю.І. Койфман, І.Г. Кальман, О.Я. Сердюков. Київ : Вид-во «Львів», 1995.

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Requirements СТЗВО-ХПІ-3.01-2021.

APPENDIX B

Examples of bibliographic description of information sources

B.1 The bibliographic description of an information source (IS) contains bibliographic information about it and consists of areas whose elements are given in a certain sequence using certain punctuation (grammatical punctuation marks and).

B.2 In general, the bibliographic description of a reference can be presented in the form of a scheme:

Main title: information related to the title / responsibility information. – Information about the publication. – Area of specific information. – Place of publication: Name of publisher, year of publication. – Issue number (for serial publications). – Physical characterization area.

To clearly separate areas and elements, use **spaces of one printed character** before and after the proposed character. Exceptions are periods and commas - spaces are left only after them. Place a full stop at the end of a bibliographic reference.

The elements of bibliographic description and punctuation are given in accordance with ДСТУ ГОСТ 7.1, taking into account the simplifications given in ДСТУ 8302, namely:

* the title should contain information about one, two or three authors, and the names of these authors should not be repeated in the bibliographic description in the information about responsibility (with a slash);
* if necessary, more than three names of authors may be indicated in the title;
* instead of the dot and dash («.-») sign, which separates the zones of the bibliographic description, it is recommended to use the full stop sign (with the use of punctuation marks being unified within the same document);
* information not taken from the title page of a document may not be enclosed in square brackets;
* the general designation of the material («Text», «Electronic resource», «Maps», «Notes», etc.) may not be indicated after the title;
* the name of the publisher may not be included in the source data;
* as part of the information on the physical characteristics of the document, one may indicate either its total volume (for example: 285 p.) or the page number on which the reference object is presented (for example: P. 19);
* it is allowed to omit information about the series and International Standard Number (ISBN, ISMN, ISSN).

B.3 The main title is given as it appears in the source of information.

Information related to the title contains information that reveals and explains the main title, for example, : textbook; : reference book; : plays for theater, etc.

**Information about responsibility** is information about the persons and organizations involved in the creation of the object of description.

Information about the edition contains information about changes and features of this edition in relation to the previous one, for example, . – Fax. ed. ; . – . 6th, ed. add; . – 10th ed.

**The area of specific information includes**, for example, the date of introduction and validity for normative documents on standardization or the registration number of an application for a patent document, the date of its filing and publication, and information about the official publication in which the information about the patent document is published.

The place of publication and the name of the publisher are indicated as they are given in the source of information, for example,. – Kharkiv : Higher education ; Kyiv : Publishing House «Sphere».

The year of publication is given in Arabic numerals**.**

For **serial publications**, indicate the issue number by type:  
 . – Issue. 2; . – №3, etc.

The physical characterization area contains the designation of the physical form in which the object of description is presented, together with an indication of the volume and, if necessary, its size, illustrations and accompanying material, for example**,**   
. – 8 vol. ; . – 106 p. ; . – pp. 11–19.

B. 6 In case of description *of normative documents on standardization* (standards and technical specifications), it is necessary to indicate the designation, number of the standard (technical specifications), date of its entry into force and title, and for collections - place of publication, name of the publisher and year of publication.

*Examples*

1. ДСТУ 3582:2013. Bibliographic description. Abbreviations of words and phrases in the Ukrainian language. General requirements and rules. Valid from 22.08.2013
2. System of labor safety standards: a collection. K. : Standards Publishing House, 2002. С.102.

B.13 If the source of information is a document posted on the Internet, the following scheme should be used to describe it:

**Main title: information related to the title / liability information // website address, date of visit to the page.**

# Appendix А An example of a horizontal arrangement of figures

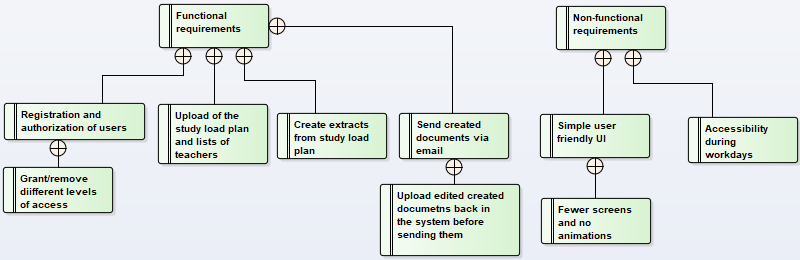


Figure B.1 – Diagram of requirements for a software solution for generating extracts from the distribution of the workload

# Appendix B Example of an application with structural sections, tables, and figures

B.1 Order of the experiment

The sequence of actions when working with the program was described in more detail in the previous sections. A shortened version of the sequence is as follows:

1. download the teaching load plan for teachers;
2. download a list of teachers and detailed data about them;
3. upload a list of teachers who are supervisors of students with term papers or diploma works assigned to them;
4. click the «Generate list of academic assignments» button;
5. click the «Generate individual plans" button;
6. click the «Generate workload distribution by teachers» button.

It was decided to additionally generate extracts using the program not only on the same data used to generate extracts without the program, but also on specially prepared workload plans for different numbers of teachers to demonstrate the benefits for different department sizes.

B.2 Results of generating extracts using the program

B.2.1 Measuring the time spent on downloading a plan

The symbols D will denote different conventional departments with different numbers of teachers in each of them, numbers 1 through 6 denote departments with 59, 33, 21, 17, 10, and 7 teachers, respectively. Measurement of time spent on loading the curriculum into the program according to the number of teachers is shown in Table B.1.

Table B.1 – Reading the course load plan by the program.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| № of the experiment | D1 | D2 | D3 | D4 | D5 | D6 |
| 1 | 29.23 | 17.01 | 12.01 | 9.67 | 7.73 | 7.53 |
| 2 | 28.69 | 17.99 | 11.28 | 8.60 | 6.94 | 6.22 |
| 3 | 30.43 | 17.00 | 11.95 | 8.92 | 7.94 | 5.32 |
| 4 | 29.49 | 18.14 | 10.74 | 10.74 | 7.78 | 7.22 |
| 5 | 28.54 | 16.61 | 11.90 | 10.59 | 7.03 | 4.99 |
| 6 | 28.18 | 18.21 | 12.06 | 9.95 | 8.70 | 6.26 |
| 7 | 28.50 | 16.63 | 12.41 | 10.06 | 6.79 | 5.34 |
| 8 | 29.78 | 18.77 | 10.46 | 10.11 | 7.08 | 5.46 |
| 9 | 29.89 | 16.51 | 11.17 | 9.08 | 6.78 | 6.50 |
| 10 | 28.88 | 18.61 | 12.61 | 10.88 | 8.29 | 4.91 |
| Sum | 23.64 | 12.32 | 6.21 | 4.46 | 2.65 | 1.42 |

B.2.2 Measuring the time spent on downloading a plan

The measurements of the readability of the list of teachers are presented in Table B.2.

Table B.2 – Time spent reading the list of teachers

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| № of the experiment | D1 | D2 | D3 | D4 | D5 | D6 |
| 1 | 5.47 | 5.14 | 7.20 | 5.43 | 4.76 | 5.57 |
| 2 | 4.88 | 7.14 | 5.35 | 7.43 | 4.48 | 4.34 |
| 3 | 3.69 | 6.16 | 5.92 | 3.52 | 4.97 | 4.02 |
| 4 | 5.30 | 5.57 | 6.40 | 6.79 | 5.57 | 5.40 |
| 5 | 5.99 | 4.18 | 3.92 | 4.35 | 5.64 | 7.18 |
| 6 | 7.48 | 5.63 | 5.47 | 5.02 | 8.18 | 5.26 |
| 7 | 4.45 | 3.84 | 6.49 | 6.45 | 4.08 | 6.96 |
| 8 | 7.19 | 5.13 | 4.41 | 6.81 | 5.53 | 5.04 |
| 9 | 3.69 | 6.39 | 6.49 | 3.79 | 7.62 | 5.75 |
| 10 | 7.50 | 5.67 | 5.89 | 5.65 | 4.38 | 6.03 |

B.2.3 Measuring the time spent on uploading a list of teachers

Measuring the time spent on uploading the list of teachers who are supervisors to the program is shown in Table B.3.

Table B.3 – Time spent reading the list of teachers and graduates

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| № of the experiment | D1 | D2 | D3 | D4 | D5 | D6 |
| 1 | 6.37 | 3.96 | 4.11 | 4.28 | 5.71 | 6.22 |
| 2 | 4.28 | 6.25 | 4.05 | 4.44 | 5.61 | 3.61 |
| 3 | 5.01 | 6.41 | 4.16 | 4.06 | 6.26 | 5.10 |
| 4 | 5.75 | 4.76 | 6.01 | 6.18 | 5.19 | 5.46 |
| 5 | 4.26 | 3.93 | 5.04 | 5.26 | 4.46 | 4.86 |
| 6 | 5.53 | 3.90 | 6.37 | 4.53 | 5.68 | 5.29 |
| 7 | 4.62 | 3.53 | 4.43 | 4.76 | 4.37 | 4.19 |
| 8 | 5.90 | 3.57 | 3.60 | 5.49 | 4.70 | 4.17 |
| 9 | 5.68 | 4.81 | 5.87 | 5.72 | 4.19 | 4.09 |
| 10 | 4.04 | 4.28 | 3.59 | 4.42 | 4.49 | 5.80 |

…

B.5 Visualization of experimental results

The graphs of the dependence of the total time of generating extracts on the number of teachers at the department are shown in Figures B.1 and B.2.

Figure B.1 – Graph of the dependence of formation time on the number of teachers using the program

Figure B.2 – Graph of the dependence of formation time on the number of teachers without using the program

Evaluation of the resulting schedule allows us to assert that the automated generation of extracts from the workload plan is much faster compared to the current approach to obtaining it. This conclusion is undoubtedly true for a department with 59 positions. The projected time for generating excerpts from the distribution of the workload without using the program is approximately more than 10 hours. The developed application allows you to get a better result in less than 2 minutes.