# 1. Introduction

## 1.1 Purpose

This document represents the software requirements specification for software intended for managing city passenger transport. The requirements specification is based on user requirements described in the task document. The target audience for the requirements specification includes project managers who will manage the development dynamics, designers and programmers who need to design and implement the software solution, and testers who will verify that the solution meets the set requirements. Besides serving as a basis for further software development, this document also acts as a contract between the client (Varaždin City Buses) and the contractor (the selected company), so the target audience includes the clients as well.

The structure of the document is based on the template defined in the IEEE 830-1998 Recommended Practice for Software Requirements Specifications document.

## 1.2 Scope

The software solution, named \_City Transport Varaždin - CTV\_, version 1.0, is being developed to digitize and optimize existing business processes within the company \_City Transport Varaždin\_. Currently, managing operations on paper presents challenges in efficiency, accuracy, and transparency of information, which this software aims to address. The software will be primarily used within the operational center of city transport and by employees responsible for planning, supervising, and managing city transport. The application will not be available to the public or passengers but will serve as an internal tool for improving organization, coordination, and communication within the company. \_City Transport Varaždin - CTV\_ represents an entirely new solution developed from scratch with the intent to replace the outdated paper-based way of record-keeping. As such, this solution integrates modern technological capabilities into the daily operations of city transport. The system will enable employees to digitally define and manage vehicles in the fleet, bus stops, schedules, and routes. It also allows access to the current location of buses to improve logistical operations and better communication with field employees. Digital ticket sales through kiosks installed near bus stops will speed up the passenger boarding process. Self-ticketing by passengers when entering the bus will increase passenger flow and reduce delays. The system will not track the current number of passengers on the bus due to technical and privacy constraints. The system will not identify passengers without tickets, focusing primarily on automating the ticket sales and validation process. The main benefits will be:

- Increased operational efficiency through the digitization of key processes.

- Reduced operational costs and time needed to manage the fleet and planning.

- Improved service quality for end-users (passengers) indirectly through optimized operations and processes.

- Enhanced security and accuracy of information thanks to centralized monitoring and management.

\_City Transport Varaždin - CTV\_ represents a key step towards the modernization and digitization of Varaždin's city transport, focusing on improving internal processes and increasing passenger satisfaction.

## 1.3 Definitions, Acronyms, and Abbreviations

\*\*CTV\*\* - City Transport Varaždin. Refers to the desktop application developed for managing city transport in Varaždin.

\*\*Schedule\*\* - A written document that contains at least: the name of the carrier, the name of the route on which the transport is performed, the type of route, the order of bus stations, passenger terminals, or bus stops and their distance from the starting point of the route, the arrival and departure times from bus stations, passenger terminals or bus stops, the schedule maintenance regime, the period in which the schedule is maintained, and the validity period of the schedule.

\*\*SRS\*\* – (Software Requirements Specification) Document that contains all detailed specifications of functionalities, requirements, and expectations from the software solution.

\*\*UI\*\* – (User Interface) Part of the application through which the user interacts with the application.

\*\*GPS\*\* – (Global Positioning System) Technology that allows real-time tracking of vehicle locations.

\*\*API\*\* – (Application Programming Interface) A set of definitions and protocols for building and integrating software applications.

\*\*RFID\*\* – (Radio-frequency identification) Wireless communication technology used for identifying and tracking tags attached to objects, including passenger tickets.

\*\*NFC\*\* – (Near Field Communication) A short-range wireless communication technology for exchanging data between devices at close proximity.

## 1.4 References

1. “830-1998 - IEEE Recommended Practice for Software Requirements Specifications.” IEEE, 1998.[Online]. Available: [IEEE Explore](http://ieeexplore.ieee.org/servlet/opac?punumber=5841)

2. Document describing the problem domain

3. Transport Act https://www.zakon.hr/z/245/Zakon-o-prijevozu-u-cestovnom-prometu

## 1.5 Document Structure

In \*\*Chapter 2\*\*, we put \_CTV\_ in context and describe the interaction with users, other systems, software solutions, hardware, and communication technologies. Then, we briefly describe the basic functions that \_CTV\_ will perform, the characteristics of the users who will use the software, and the constraints that may affect the development of the software solution.

In \*\*Chapter 3\*\*, we define the functional requirements for \_CTV\_ at a level of detail sufficient for designers and programmers to begin designing and implementing the solution, and for testers to design test cases.

In \*\*Chapter 4\*\*, we define the non-functional requirements for \_CTV\_ that designers and programmers need to consider when designing the architecture, selecting implementation technologies, and approaches.

In \*\*Chapter 5\*\*, we visualize the way users interact with the \_CTV\_ system by sketching the graphical user interface.

# 2. General Description

## 2.1 Product Perspective

\_CTV\_ will be a standalone software solution that will digitize all business processes that make up the city transport system. There will be a database containing information about the fleet, bus stops, schedules, and passenger feedback. Using GPS, it will enable precise tracking of each bus, improving logistical efficiency and allowing passengers to get accurate arrival time information. Communication protocols (e.g., TCP/IP) will be used for reliable data exchange between buses, the control center, and bus stops. \_CTV\_ is designed to run on standard operating systems, providing flexibility in application implementation and use. Integration with external web services and APIs will allow \_CTV\_ to access additional information and functionalities, such as traffic condition updates or integration with payment systems for ticket purchases. Although \_CTV\_ is primarily a software solution, integration with certain hardware components such as GPS devices in buses, ticket kiosks, and card readers is foreseen, using interfaces like Bluetooth, NFC, and IC technologies.

## 2.2 Product Functions

Future users of the \_City Transport Varaždin\_ software solution expect the software to provide the following capabilities:

- Defining vehicles in the fleet, bus stops, routes, and schedules

- Viewing defined routes and schedules

- Knowing the current location of individual buses

- Clear display of bus routes and schedules at the stop and the arrival time of the next bus

- The ability to purchase tickets

## 2.3 User Characteristics

Users who will use the \_City Transport Varaždin\_ software solution are \*\*employees\*\* of city transport with various roles: IT support, maintenance technicians, administrators, route planners, drivers. This group includes a high level of knowledge of internal processes within the city transport system but varying levels of technical literacy. IT support and technicians have a high level of technical and computer literacy, specialized knowledge of the hardware and software used by the system. Administrators and planners will have a medium to high level of technical literacy, while drivers may not be as technically trained. They will have different levels of permissions: high for IT support, technicians, and administrators, medium for planners, low to medium for drivers. The second group of users is \*\*passengers\*\*, including students, retirees, and workers. There is a diversity in technical literacy, with retirees possibly having a lower level of technological literacy, while students and workers are likely to have a high level of literacy and expectations from digital services. They have no administrative permissions but have access to information about routes, ticket purchases, and can send feedback.

## 2.4 Constraints

The development and implementation of the \_City Transport Varaždin\_ system face a number of constraints that may affect the development process, functionality, and scope of the project. These constraints include:

- GDPR: To ensure compliance with GDPR, mechanisms must be implemented to protect passenger and employee data, including secure storage and processing of personal data.

- Fiscal regulations: If the system includes transactions such as ticket sales, compliance with local fiscal regulations must be ensured.

- Hardware compatibility: Although \_CTV\_ is primarily a desktop application, interaction with existing hardware components (e.g., GPS devices, ticket kiosks) may present constraints in terms of compatibility, device performance, and connectivity.

## 2.5 Assumptions and Dependencies

\_CTV\_ depends on external technologies and services, including GPS for vehicle tracking, operating systems on which the application will run, and APIs for integration with payment platforms and web services. The release of new versions of these technologies or APIs may require additional development work to maintain compatibility. It is assumed that existing hardware resources (e.g., GPS devices in buses, ticket kiosks) have sufficient capacities and capabilities for integration with the \_CTV\_ solution. Changes in the availability or specifications of hardware may affect the development and implementation of the software. It is assumed that user habits and preferences will remain relatively constant, allowing accurate prediction of transport demands and alignment with planned schedules. Potential expansion or changes in city infrastructure, such as the construction of new roads or changes in the layout of bus routes, may affect the planning and management of schedules.

## 2.6 Other

No additional aspects need elaboration.

# 3. Functional Requirements

| \*\*Identifier\*\* | \*\*FZ-1\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will allow the display of the currently valid schedule of all routes. |

| \*\*Rationale\*\* | Enables employees and passengers to be timely informed about the schedule. |

| \*\*Verification\*\*

| An authenticated user accesses the system and checks the accuracy of the schedule display for a specific route. |

| \*\*Priority[1-5]\*\* | 1 |

| \*\*Source\*\* | User requirements |

| \*\*Identifier\*\* | \*\*FZ-2\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will allow authorized personnel to enter and update the schedule. |

| \*\*Rationale\*\* | Ensures the accuracy and currency of schedule information. |

| \*\*Verification\*\* | An authorized user enters changes in the schedules and checks the data update in the system. |

| \*\*Priority[1-5]\*\* | 1 |

| \*\*Source\*\* | User requirements |

| \*\*Identifier\*\* | \*\*FZ-3\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will allow generating reports on ticket sales and vehicle occupancy. |

| \*\*Rationale\*\* | Provides data necessary for analysis and financial planning. |

| \*\*Verification\*\* | An authorized user generates a report for a specific period and checks the completeness of the collected data. |

| \*\*Priority[1-5]\*\* | 2 |

| \*\*Source\*\* | User requirements |

| \*\*Identifier\*\* | \*\*FZ-4\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will allow displaying statistics on the use of routes and bus stops. |

| \*\*Rationale\*\* | Enables better planning and resource allocation based on actual usage. |

| \*\*Verification\*\* | An authorized user accesses usage statistics and checks the accuracy of the displayed data. |

| \*\*Priority[1-5]\*\* | 3 |

| \*\*Source\*\* | User requirements |

| \*\*Identifier\*\* | \*\*FZ-5\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will allow real-time tracking of each bus location. |

| \*\*Rationale\*\* | Provides the ability for supervision and better traffic planning. |

| \*\*Verification\*\* | An authorized user checks the accuracy of the bus location displayed on the map in the system. |

| \*\*Priority[1-5]\*\* | 1 |

| \*\*Source\*\* | User requirements |

| \*\*Identifier\*\* | \*\*FZ-6\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will allow digital ticket sales through kiosks. |

| \*\*Rationale\*\* | Facilitates the ticket purchase process and reduces waiting time. |

| \*\*Verification\*\* | Testing ticket purchase at the kiosk and checking the printed ticket. |

| \*\*Priority[1-5]\*\* | 2 |

| \*\*Source\*\* | User requirements |

| \*\*Identifier\*\* | \*\*FZ-7\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will allow issuing personalized reports for drivers. |

| \*\*Rationale\*\* | Helps drivers monitor their daily routes and obligations. |

| \*\*Verification\*\* | A driver requests a report on their daily routes and checks the accuracy and completeness of the information. |

| \*\*Priority[1-5]\*\* | 3 |

| \*\*Source\*\* | User requirements |

| \*\*Identifier\*\* | \*\*FZ-8\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will allow automatic schedule updates in case of changes. |

| \*\*Rationale\*\* | Ensures that all users can rely on the accuracy of schedule information. |

| \*\*Verification\*\* | An authorized user makes a change in the schedules, and the system automatically notifies passengers of the change. |

| \*\*Priority[1-5]\*\* | 4 |

| \*\*Source\*\* | User requirements |

| \*\*Identifier\*\* | \*\*FZ-9\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will allow managing employee profiles. |

| \*\*Rationale\*\* | Enables updating and maintaining employee data. |

| \*\*Verification\*\* | Adding a new employee and changing the data of an existing employee in the system. |

| \*\*Priority[1-5]\*\* | 3 |

| \*\*Source\*\* | User requirements |

| \*\*Identifier\*\* | \*\*FZ-10\*\* |

|------------------|--------------------------------------------------------------------------------------------------------|

| \*\*Requirement\*\* | The system will display bus delay notifications within the desktop application. |

| \*\*Rationale\*\* | Helps in coordination between drivers and the control center. |

| \*\*Verification\*\* | Checking the display of delay notifications within the application after detecting a delay using GPS data. |

| \*\*Priority[1-5]\*\* | 3 |

| \*\*Source\*\* | User requirements |

## 3.1 Implementation Dynamics of Requirements

In the initial version of the software, only the highest priority requirements will be implemented. This includes:

- \*\*FZ-1\*\* - The system will allow the display of the currently valid schedule of all routes.

- \*\*FZ-2\*\* - The system will allow authorized personnel to enter and update the schedule.

- \*\*FZ-3\*\* - The system will allow generating reports on ticket sales and vehicle occupancy.

- \*\*FZ-5\*\* - The system will allow real-time tracking of each bus location.

- \*\*FZ-6\*\* - The system will allow digital ticket sales through kiosks.

In subsequent versions, the implementation of other requirements is planned:

- \*\*FZ-4\*\* - The system will allow displaying statistics on the use of routes and bus stops.

- \*\*FZ-7\*\* - The system will allow issuing personalized reports for drivers.

- \*\*FZ-8\*\* - The system will allow automatic schedule updates in case of changes.

- \*\*FZ-9\*\* - The system will allow managing employee profiles.

- \*\*FZ-10\*\* - The system will display bus delay notifications within the desktop application.

# 4. Non-Functional Requirements

\*\*NFZ-1\*\* The system will provide an intuitive user interface that aligns with the latest design trends, ensuring a pleasant user experience and ease of navigation.

\*\*NFZ-2\*\* The system will allow for future expansion of the number of users and data volume without affecting performance, ensuring long-term usability and efficiency.