University of Economics, Prague

Faculty of Informatics and Statistics

Developing a Field Service Management system using Microsoft 365

BACHELOR THESIS

Study program: Aplikovaná informatika

Author: Štěpán Houdek

Supervisor: Ing. Iva Stanovská

Prague, April 2021

Declaration

I declare that I wrote Developing a Field Service Management System using Microsoft 365 by myself and using sources named in references.

In Prague 25. April 2021 .....

Štěpán Houdek

Acknowledgment

To Tomáš Mejzlík for the first idea of the system and his kind leadership. To Michal Erlich for approving the project. To Markéta Smolníková for general advice. To my thesis supervisor Iva Stanovská for valuable inputs and willing help in all areas.

Abstract

Small and medium enterprises in Czechia significantly lack behind in integration of digital technology compared to large enterprises. Many of the small companies still rely on paper and pen or Excel sheets to assign work, keep records of employees' working hours and work-related information which is not only time-consuming but often leads to erroneous results. The aim of this bachelor thesis is to assess the feasibility of development and implementation of a field service management system by a non-developer accessible to small and medium enterprises.

The development of the system is formalized by using some practices of the Agile Modeling while information pertaining to the development is stored using the Diary-Driven Development approach. The development is led by a single person using only tools available in the Microsoft 365 package. After the development is finished, the system is implemented in a small enterprise. To test the hypothesis that a small enterprise will accept such system, an expectation confirmation theory is used to assess the satisfaction of the end consumer. The hypothesis is confirmed by excellent customer feedback.

Abstrakt

Malé a střední podniky v České republice významně zaostávají v integraci digitálních technologií oproti velkým podnikům. Mnoho malých podniků stále využívá papír a tužku nebo Excel tabulky pro přiřazení pracovních úloh, uchovávání informací o pracovní době a dalších informací o zaměstnancích, což je nejen časově náročné, ale často vede i k nepřesnému zápisu informací. Cílem této práce je vyvinout a implementovat bez profesionálních vývojářů systém na správu servisních požadavků dostupného pro malé a střední podniky.

Vývoj systému je formalizován využitím některých Agile metod, dokumentace informací o systému je tvořena za využití Diary-Driven Development přístupu. Vývoj je veden jednou osobou za využití nástrojů pocházející pouze z balíčku Microsoft 365. Po dokončení vývoje je systém implementován v malém podniku. Pro ověření hypotézy, že malý podnik systém akceptuje byla použita teorie potvrzení očekávání. Hypotéza je potvrzena zpětnou vazbou zákazníka.

Keywords

Bookings, Field Service Management, Power Apps, Power Platform

JEL Classification

L86

Content

Introduction 9
1 Field service management 11
1.1 Field technicians work planning and dispatching 11
1.2 Time and location tracking 12
2 Microsoft 365 14
2.1 Microsoft SharePoint Online 14
2.2 Power Apps 15
2.3 Microsoft Bookings 16
2.4 Microsoft Planner 16
2.5 Microsoft OneNote 17
3 Methodology 18
3.1 Agile Modeling 18
3.1.1 Just Barely Good Enough 19
3.1.2 Requirements Envisioning and Architecture Envisioning 19
3.1.3 Prioritized Requirements 20
3.1.4 Iteration Modeling 21
3.1.5 Value 21
3.1.6 Document Continuously 21
3.2 Diary-Driven development 22
3.2.1 Design Decisions Diary 22
3.2.2 Code Change Diary 23
3.2.3 The Random Thoughts Diary 23
3.3 Implementation of the methodology 23
3.3.1 Just Barely Good Enough 23
3.3.2 Requirements Envisioning and Architecture Envisioning 23
3.3.3 Prioritized Requirements 24
3.3.4 Iteration Modeling and Value 24
3.3.5 Document Continuously and Diary-Driven development 24
4 Development of Magenta Time 26
4.1 Design choices 26
4.2 Pre-release development generations 29
4.2.1 Generation 0 29
4.2.2 Generation 1 29

4.3 First release generation 30
4.3.1 Magenta Track 31
4.3.2 Magenta Plan 45
4.3.3 SharePoint data storage 47
4.4 Deployment of Magenta Time 50
5 Pilot customer evaluation 51
5.1 State before Magenta Time 51
5.2 Pilot customer feedback 51
5.2.1 User 1 52
5.2.2 User 2 53
6 Comparison of available solutions 55
6.1 Company 1 56
6.2 Company 2 56
6.3 Company 3 57
6.4 Magenta Time 57
6.5 Worldwide available solutions 57
Conclusions 58
List of references 62
Annexes 65
Annex A: PowerShell deployment of a SharePoint list 65

List of tables

Table 1 Agile Modeling categories and practices (data Scott W. Ambler, own visualization) 18
Table 2 Agile criteria (data Scott W. Ambler, own visualization) 19
Table 3 Design choices comparison – Exchange Online 26
Table 4 Design choices comparison - Sharepoint Calendar 27
Table 5 Design choices comparison - Microsoft Bookings 28
Table 6 UA1 - Welcome Screen 31
Table 7 UA2 – View calendar 33
Table 8 UA2 - Calendar overview and recording start of work 35
Table 9 UA3 - Recording end of work 37
Table 10 UA4 - View finished tasks 39
Table 11 UA5 – Edit finished task 41
Table 12 UA6 – View tasks auction 43
Table 13 UA7 - Accept auction task 44
Table 14 Overview of the Sharepoint list structure 48

List of figures

Figure 1 Microsoft Power Platform (Microsoft) 15
Figure 2 Visualization of the Agile Modeling categorization (Scott W. Ambler) 18
Figure 3 Just Barely Good Enough visualization (Scott W. Ambler) 19
Figure 4 Requirements management in Disciplined Agile (Scott W. Ambler) 21
Figure 5 Document Continuously and Traditional documentation approach comparison (Scott W. Amlber) 22
Figure 6 Product backlog in Microsoft Planner (own visualization) 24
Figure 7 Random thoughts diary in Microsoft OneNote (own visualization)..... 25
Figure 8 First screen of the task planning application (own visualization)..... 29
Figure 9 Magenta Plan calendar overview (own visualization) 30
Figure 10 Magenta Track use case diagram (own visualization).....31
Figure 11 Magenta Plan task planning (own visualization)..... 46
Figure 12 Magenta Plan use case diagram (own visualization)..... 47
Figure 13 Datasource use case diagram (own visualization)..... 49
Figure 14 Pilot customer's calendar and service sheet (Pilot customer).....51

Introduction

Overall, the level of integration of digital technology in Czech companies is above the EU's average. However, small and medium enterprises defined by the European Commission (2003) as enterprises with headcount below 250 and turnover below 50 million Euro or balance sheet total below 43 million Euro significantly lack behind large enterprises in areas such as cloud adoption, where the number of companies having adopted cloud in the large enterprise segment is two times bigger than in the medium and small enterprise segment (European Commission 2020).

Digitalization and specifically cloud adoption are the driving forces of today's technology. Gartner forecasts that in two years, from 2020 to 2022, the worldwide public cloud services end-user spending will grow by 40 %. One cloud domain is the software as a service (SaaS) which Gartner defines as "software that is owned, delivered and managed remotely by one or more providers." Spending for SaaS in the same period is forecasted to grow by 36 % (Gartner 2019).

Microsoft 365 is the productivity cloud offering a wide range of services to companies from the smallest to the largest. Its appeal lies in uniformity of the offered tools. Power Apps is part of the Microsoft's solution, enabling users to create both simple and complex applications, such as Field Service Management system.

Gartner (2021d) defines Field Service Management (FSM) as "A discrete market within the broader customer service and support software market. Field service providers typically dispatch technicians to remote locations to provide installation, repair or maintenance services for equipment or systems." A flexible FSM system offers many benefits to companies with a mobile work force, being a great step towards their digital future. It provides the employer with an easy-to-use tool to plan and assign work tasks, at the same time it serves employees a simple but accurate way of recording the start and completion of the assigned tasks. As described by Uddin et al. (2014), The accuracy of the time tracking helps to reduce over-payment otherwise caused by inaccurate (non-digital) time tracking. Moreover, reduction of manual processes by digitalization saves resources. The final benefit being the compliance with labor regulation since it is required of a company to record the working hours of their employees.

This thesis aims to assess whether it is possible for a non-developer to design and implement a FSM system which will be accepted by the business. Benefits to the business will be evaluated. The system may be developed using only tools available in the Microsoft 365 Business Basic package, so both the developer and the user do not need to pay for additional licenses.

Firstly, the induction approach is chosen to create the first set of requirements for the proof-of-concept system, specifically research of the status of FSM system's features combined with brainstorming. Secondly, after having developed and implemented the system in a

company, deduction is used to test the system and from concrete customer experience build the second set of requirements used in future development.

The development environment of choice is Microsoft's Power Platform, specifically the Power Apps. The platform is built on simplicity and the "low-code" principle, significantly shortening the application development life cycle (Computer 2020). With simplicity comes cost-effectiveness brought by the lower development efforts. On top of that, a specific feature of this FSM system called Magenta Time is its strong competitive implementation price. With the Power Apps solutions, the application requires only a Microsoft 365 Basic license and a GPS enabled smartphone. The application for managers requires a purchase of a license of approximately double the employees' license price.

Firstly, the status of development in the fields of FSM and time and location tracking is introduced. Following is the summarization of features of Microsoft 365 relevant to this thesis. Ensuing is an overview of methodology and its practical application in the development of Magenta Time. Following is the description of the Magenta Time system and its deployment and evaluation by the pilot customer. Final chapter shows the comparison of Field Service Market solutions already available on the Czech market.

The contribution this thesis presents is firstly a proposal of methods that may be used for simple application development by individuals or small teams. Secondly, it supports Microsoft's vision of Power Platform enabling individuals or small teams to develop fully functional applications supporting various business needs (Maheshwari 2021). Thirdly, the thesis describes a new budget friendly FSM solution for the SME market enabling innovation of small and medium sized companies.

1 Field service management

Gartner (2021a) states that Field service management "includes the detection of a field service need (through remote monitoring or other means, inspection or a customer detecting a fault), field technician scheduling and optimization, dispatching, parts information delivery to the field, and process support of field technician interactions." Literature pertaining to Magenta Time will be investigated further, specifically field technicians planning and dispatching software and time and location tracking software.

1.1 Field technicians work planning and dispatching

There is a large pool of theoretical background for the field technician scheduling problem. Cordeau et al. (2010) describe an algorithm for scheduling technicians and tasks including maintenance, installation, or construction jobs in a telecommunications company with requirements such as differentiation of technicians' skill levels in various domains. Wang et al. (2021) described the results of implementing artificial intelligence for service task scheduling in a field service company with a workforce of 20 000 field technicians. For each field task, a particular set of skills is required. Another requirement was to give the field technicians a certain amount of flexibility to choose which service tasks to accept. An AI model which took all requirements into consideration was developed and implemented, resulting in improvement of planned tasks accuracy by 10 %, 10 % increase in resource productivity and 17 % travel time reduction in some parts of the business.

Agnihothri et al. (2002) propose a theoretical framework for leveraging technology to improve field service. Terms facility based and field-based services are defined. Facility based meaning that the customers access the service facility, opposed to field based where it is a responsibility of the service provider to service the customer's possessions located at the customer's site. Furthermore, field-based services are divided into three categories:

- pick-up/delivery services,
- emergency services,
- after-sales service support.

After-sales support is further divided into three markets:

- capital equipment such as office computers,
- consumer goods such as personal computers,
- utilities such as telephone service.

For companies managing the after-sales service support, the importance of managing both the service request response time and technician on site time is stressed.

1.2 Time and location tracking

In most of the recent papers discussing the location and time tracking systems, data from smartphones is used as input. Features of modern smartphones include GPS, which may be used to record employee location. Data may be stored either on-premises or in the cloud.

Sultana et al. (2015) introduce a location-based attendance tracking system using an Android application installed on a smartphone, continuously tracking the user's GPS, and automatically creating a new record when entering the predefined office geo-fence, afterward sending the data to on an on-premises server database.

The possible fraudulent recording of attendance by employees is addressed by multiple papers offering different advanced authentication methods making use of technologies such as a fingerprint scanner, camera, or microphone.

Soewito et al. (2016) present a smart attendance smartphone application with advanced authentication using voice recognition and fingerprint scanning. The system is connected to a payroll system which subsequently makes salary calculation easy. The disadvantages of traditional attendance systems are described, for example a potential queue creation in front of the attendance recording device. The information recorded by the mobile application, which needs to be manually recorded by the employee with a press of a button is date, time, android device ID, phone number, GPS coordinates and employee's fingerprint.

Arsenovic et al. (2017) suggest a deep learning-based face recognition attendance system making use of the developments in the deep convolutional neural networks (CNNs) area for face detection and recognition. User authentication accuracy achieved using a small dataset of their face pictures to train the deep learning model reached 95.02 %.

Kamelia et al. (2018) propose a real-time, online attendance recording method. Fingerprint is used for employee authentication. Option of instantly sending newly recorded attendance data to the employees' managers using a Multimedia Messaging Service (MMS) is demonstrated.

Oo et al. (2018) introduce a cloud-based web application with NFC for employee attendance management system. Employees record their attendance by placing their identification card in a proximity of an NFC reader. Future releases of the system will include the option to substitute the identification card with an NFC-enabled smartphone.

Kotevski et al. (2018) conducted an exhaustive review and comparison of available technologies and systems for student attendance tracking. The result of the comparison is that web technologies are best suited for recording the information. They offer slightly lower level of security compared to for example fingerprint recognition but prove to be superior in many other aspects such as implementation cost or maintenance cost.

Concluding, the abovementioned overview of resources was used to identify information which should be recorded by the technician. Inspiration for future development was collected, mainly the option of integration with an on-premises databases, a modern way of employee identification using face recognition, the possibility to send an MMS to managers and the option of implementing AI or mathematical algorithms for service task planning.

2 Microsoft 365

In this chapter, a broad overview of the Microsoft 365 productivity cloud is given with a focus on services relevant to development of Magenta Time.

Microsoft 365 is the productivity cloud presenting a wide array of services to businesses such as an email account, storage account, tools for note taking, task management, task assignment and an online version of the Office programs. The complete Microsoft 365 cloud ecosystem which Magenta Time is a part of provides an end-to-end cloud solution to companies of all sizes with a service level agreement including 99.9 % uptime. The business model is based on monthly license fees, each license offering a different array of services, from the most basic to the most advanced. Magenta Time requires two kinds of licenses, Microsoft 365 Business Basic and Standard. Features included in the Basic license as of February 10, 2021 are as follows:

- Outlook
- OneDrive
- Online version of the Office programs
- SharePoint
- Microsoft Teams
- Microsoft Power Platform

Microsoft 365 Business Standard adds desktop versions of the Office programs and importantly for Magenta Time also access to Microsoft Bookings (Microsoft 2021a). In the sub-chapters below, the individual services used by Magenta Time are described.

2.1 Microsoft SharePoint Online

Microsoft SharePoint is a web-based collaborative platform used for creating both internal and external facing sites accessible only when authenticated with a Microsoft account. The service provides many capabilities. Some of the use case scenarios are:

- enterprise content and document management,
- intranet or social network,
- collaborative hub,
- file hosting.

Data may be stored in lists, flexible collections comprised of uniquely named columns allowing storing of different data types such as text, numbers, or attachments. Single entries in lists are called items which may be added either by using the web interface, an API call, a PowerShell script or a Power App (Microsoft 2021b).

2.2 Power Apps

Microsoft's Power Platform is a low-code platform enabling users to create both simple and complex solutions. It comprises of various applications, see Figure 1:

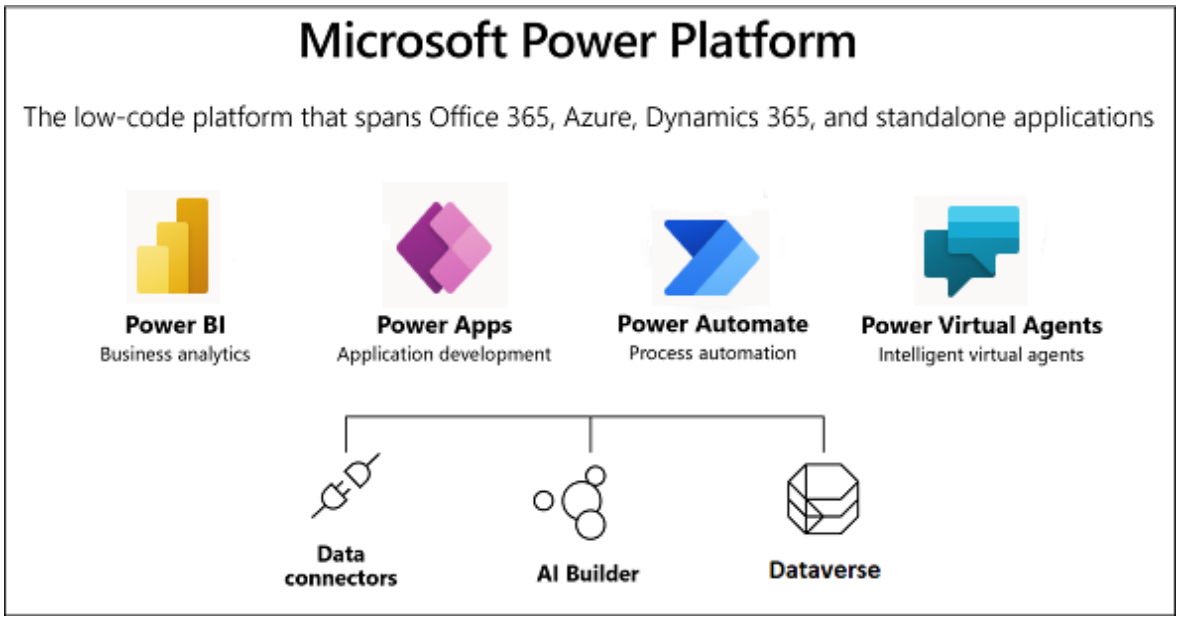


Figure 1 Microsoft Power Platform (Microsoft)

Power Apps is part of the Power Platform. According to the study "The Total Economic Impact Of Power Apps" conducted by Forrester and paid by Microsoft, Power Apps saves companies 74 % of app development costs and the return of investment after three years reaches 188 % (Microsoft 2020). PowerApps is primarily aimed at users with little to no programming knowledge and/or experience but wanting to transform their business needs into working applications. According to the above-mentioned study, the maintenance cost of applications is significantly lowered, and development becomes much faster. A simple Power App may be created within hours, not days, weeks or months using other platforms for standard development. Power Apps supports a wide variety of data sources inside and outside of Microsoft 365 such as SharePoint site document libraries or lists, databases running either in cloud or on-premises, other online services and many other options made available by the possibility to develop custom connectors. When creating a Power App, the user may choose between a canvas app, a model-driven app, and a portal.

Development of canvas applications starts with the user experience. The developer is either greeted with a blank canvas or when choosing to begin with a template a pre-defined set of elements. The app is built by dragging and dropping elements onto the canvas, like designing a PowerPoint slide. Behind these seemingly simple elements the user may define complex, Excel-like expressions powering the application logic (Microsoft authors 2020c) .

Development of model-driven applications starts with data stored in Microsoft Dataverse, formerly called Common Data Service. The development experience is much different from the canvas applications. Firstly, the business data needs to be modeled, determining what data the application will require and what are the data relationships. Secondly, the business

processes need to be defined, ensuring the users may focus on their work and not long manual processes. Thirdly, the model-driven application is composed using the previously prepared components (Microsoft authors 2020b; Orth 2018).

As canvas and model-driven applications were internal-facing, Power Apps portals are external-facing websites that allow users outside of the organization to log in using their credentials from various providers including a Microsoft account or social sites such as Facebook or Twitter. The main purpose of portals is to allow user outside of the organization to securely access and interact with the company's data. A disadvantage of portals for the SME sector is their high price. As of writing this thesis, the cheapest offering without authentication costs 100 USD per month (Microsoft authors 2021b; Microsoft 2021d).

2.3 Microsoft Bookings

Microsoft Bookings is a scheduling tool allowing business to setup both an internal and external facing interface for managing booking of services. It consists of three main components:

- A service company's customer facing booking page for creation and management of their service bookings.
- A business-facing web app used for modifying settings of Bookings and features such as setting working hours of the business during which service bookings may be created, customizing the customer facing page design, or scheduling email reminders before an appointment starts.
- A business-facing mobile application for managing service bookings on the go (Microsoft authors 2020a).

2.4 Microsoft Planner

Microsoft Planner is a Kanban solution offering a way of organizing teamwork and tasks. A hub is provided for the members of the team to create plans and tasks, assign tasks to users and view updates and progress through dashboards. Planner is integrated with the rest of the Microsoft 365 ecosystem. It may be easily shared with a team in Microsoft Teams. Notifications are sent via email or the Microsoft To-Do mobile application.

Tasks in Planner may be assigned to one or multiple users and are organized in buckets. Each bucket has its own name. Tasks may be easily moved between buckets, using the drag and drop functionality. There are multiple options of sorting and filtering in Planner based on a variety of tasks' features such due date, priority, label, or user assigned. When task is finished, one click moves in into the finished tasks category (Microsoft 2021e).

2.5 Microsoft OneNote

OneNote is a digital note taking application offering a user interface like a classical paper notebook. Multiple notebooks may be created in OneNote. Each notebook contains sections, and each section contains pages. Text or pictures may be inserted into pages (Microsoft 2021c).

3 Methodology

The aim of this chapter is to describe the methodology used throughout the development of Magenta Time and its implementation using tools available in the Microsoft 365 package.

Development of the system will be formalized by using some practices of the Agile Modeling (AM) described by Scott W. Ambler (2020), the Vice President and Chief Scientist for Disciplined Agile at Project Management Institute. Documentation will be created using the Diary-Driven Development approach as described by Dent et al. (2008).

3.1 Agile Modeling

AM is a practice-based methodology for modelling and documentation of software systems. It is meant to be tailored into other, full-fledged methodologies such as Scrum or RP but for the purpose of this project a lightweight version of AM will be enough.

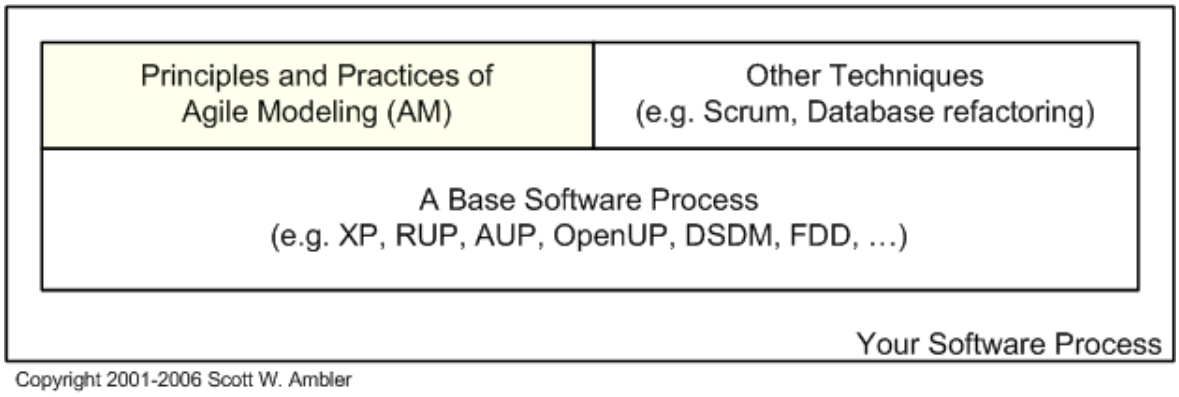


Figure 2 Visualization of the Agile Modeling categorization (Scott W. Ambler)

The practices of AM are divided into categories as shown below. Practices chosen to be used in the development process are highlighted using grey.

Table 1 Agile Modeling categories and practices (data Scott W. Ambler, own visualization)

Modeling techniques	Active Stakeholder Participation	Multiple Models	Just Barely Good Enough	Inclusive Tools and Techniques
Modelling sessions	Agile Modeling Session	Look-Ahead Modeling	(JIT) Model Storming	
Session types	Requirements Envisioning	Architecture Envisioning	Iteration Modeling	
Specification strategies	Single Source Information	Executable Specifications	Document Continuously	Document Late

Related techniques	Prioritized Requirements	Test-Driven Development (TDD)

Furthermore, Ambler (2020) describes the following criteria for determining whether a team is agile. Criteria chosen to be used in the development process are highlighted using yellow.

Table 2 Agile criteria (data Scott W. Ambler, own visualization)

Agile criteria	Value	Validation	Stakeholder Involvement	Self-organization	Continual Improvement

3.1.1 Just Barely Good Enough

According to Ambler (2020), Just Barely Good Enough (JBGE) is the most effective way to develop. One reaches the point where it is exactly the right amount of time and work invested into a task to be the most effective. Investing more time into the task would not lead to more value since one's time may be invested in another area which has not reached the JBGE point.

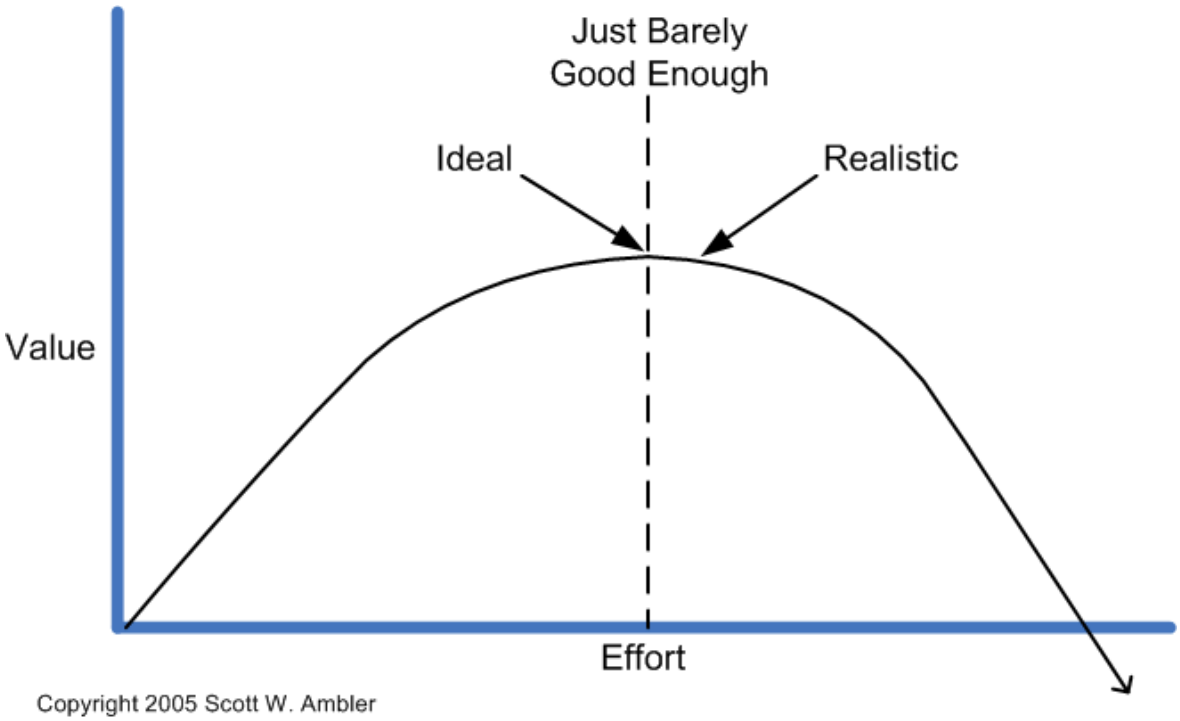


Figure 3 Just Barely Good Enough visualization (Scott W. Ambler)

3.1.2 Requirements Envisioning and Architecture Envisioning

The usual agile practice is that some form of high-level Requirements Envisioning and Architecture Envisioning is done early in the project to create a model which defines a basic

common understanding of the scope and architecture to be used. The requirements are written down into the Product Backlog. JBGE may be combined with the practices to reach the maximum value of the architecture and requirements models with maximum possible efficiency.

3.1.3 Prioritized Requirements

Since software development requirements change frequently, a developer needs a flexible approach to requirements change management. Agile approach to change is not trying to prevent it but to embrace and manage it.

Ambler (2020) mentions three approaches to this practice, two of which are described in this thesis:

Product backlog (SCRUM)

The SCRUM methodology describes the product backlog, a prioritized set of items which the software development team needs to address. At the start of the project, the backlog is filled based on the requirements envisioning practice. Afterwards, new requirements are prioritized by the project stakeholders and added to the backlog. One person needs to have the final authority over the prioritization. At the start of each iteration ("sprint" in the SCRUM terminology), the development team commits to implementing some or all requirements, starting from the top of the backlog with highest priority items.

Product backlog is meant to be used for simple agile development projects. The disadvantage is that there needs to be an "overhead fudge factor" accounting for work not directly related to development requirements.

Work item list (Disciplined Agile)

Compared to the SCRUM backlog, the Disciplined Agile extends the view of requirements to incorporate non-requirement related work such as addressing bugs or training of the team members. Another addition is that of modelling a bit ahead since some requirements cannot be developed within one iteration. A more complex, long-term modeling process is required to minimize the project risk of these items.

Advantage of this approach is that the "overhead fudge factor" is minimized or removed completely, being incorporated into the work item list itself.

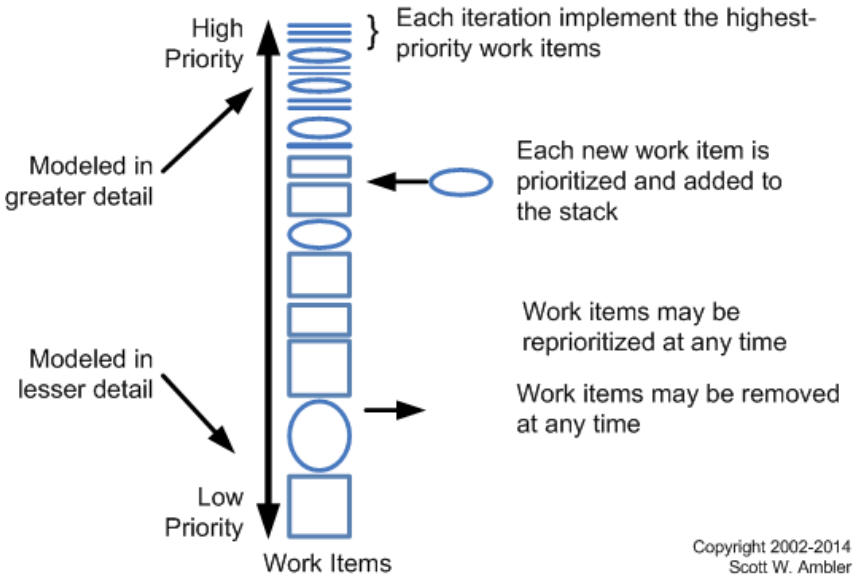


Figure 4 Requirements management in Disciplined Agile (Scott W. Ambler)

3.1.4 Iteration Modeling

At the beginning of each development cycle (iteration) it is advised to plan which requirements from the prioritized list of choice will be implemented. To be able to fulfil the requirements, one needs to understand the amount of work needed to finish them, discussing the possible ways of implementing the chosen requirements.

3.1.5 Value

The value criteria are based on delivering value to the project stakeholders on a regular basis. In the Disciplined Agile methodology this is achieved by producing a consumable solution every iteration. A consumable solution means more than just a working software solution, complementary to it is supporting documentation, description of business process changes and more.

3.1.6 Document Continuously

When the goal is delivering a consumable solution each iteration, maintaining documentation in sync with development efforts is key. The other option is to write the documentation at the end of the project, to document late. Ambler (2020) suggests to always wait for the information to stabilize before creating documentation as not to have to change what has been written.

Advantages of documenting continuously

Advantages of this practice are mitigating delivery and accuracy risks. The solution will be shippable with all the documentation needed at the end of each iteration. Accuracy is higher since all the details which need to be written down are still fresh and not forgotten.

Disadvantages of documenting continuously

Disadvantages are a potential financial risk, schedule risk and accuracy risk. It is highly possible that it will be needed to rewrite the documentation as the project evolves. Some parts of the project might not be used at the end, documentation for which may be discarded. On top of that, writing documentation takes time, creating a risk of not being able to stick to the project schedule. Finally, documenting continuously might look nice in theory, but developers often put off writing down documentation, effectively starting to use the "document late" practice.

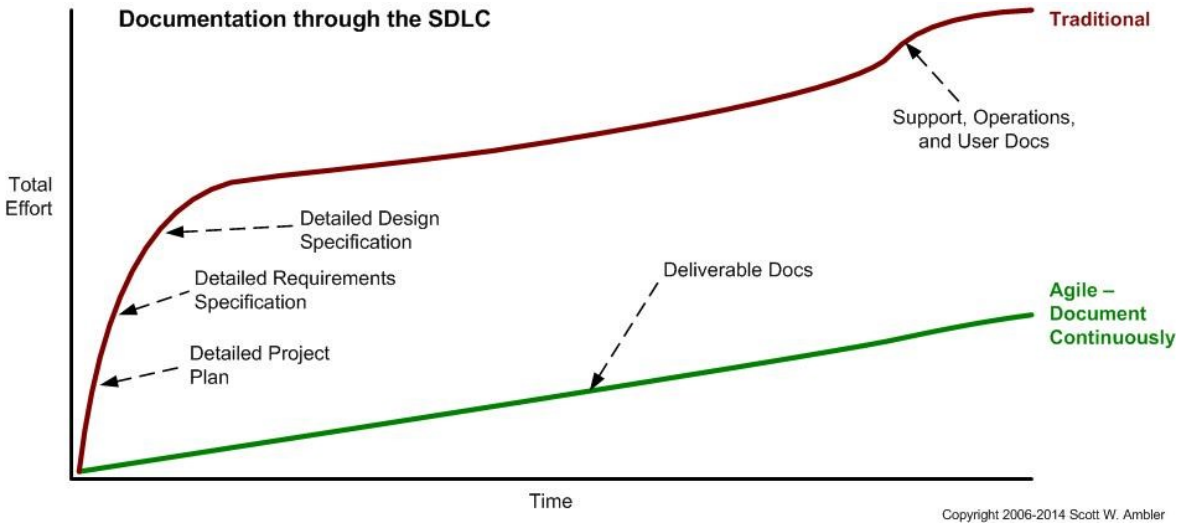


Figure 5 Document Continuously and Traditional documentation approach comparison (Scott W. Amlber)

3.2 Diary-Driven development

Diary driven development, as described by Dent et al. (2008), is a "just-sufficiently-formal" approach to creating software documentation. The main principle is creating a series of diaries which might contain overlapping information but have their distinct purposes. This approach may be used in conjunction with the previously mentioned Agile Modeling.

3.2.1 Design Decisions Diary

This diary is meant to contain information about the software design choices, pros and cons of individual designs and discussion of individual choices made. The diary might contain information following a structure:

- short description of an issue to be decided,
- list of alternative designs,
- advantages and disadvantages for each design,
- description of the final design.

3.2.2 Code Change Diary

The code change diary contains detailed information about all code changes. If the information is detailed enough, one can then revert the changes made based on the entries. The diary might follow the structure of:

- headings containing the main reason for the code change,
- short description for each code change,
- where necessary a line-by-line description of all changes made.

3.2.3 The Random Thoughts Diary

This diary does not need to follow a given structure. The purpose of this diary is to have a place where to put distracting random thoughts as they come, not interrupting the flow of work, and having an option to come to these thoughts later.

3.3 Implementation of the methodology

At the start of the development a senior colleague presented a FSM proof of concept application design. Based on that, the generation 1 of Magenta Time was developed. The system was then presented to a customer who provided feedback. Based on the feedback, generation 2 of the system was developed.

3.3.1 Just Barely Good Enough

Since the system was developed by a single developer, adhering to the JBGE practice is key for being able to deliver a complete solution in reasonable time. Before starting the development of each feature from the product backlog, the developer tries to assess what is the JBGE point for that feature and attempts to invest just enough time into the development process.

3.3.2 Requirements Envisioning and Architecture Envisioning

At the start of the development, very simple requirements and architecture envisioning were performed. The architecture envisioning did not go much in depth since no-one involved in the project had a deep enough understanding of the Microsoft Power Platform.

A more thorough architecture envisioning was done after having finished generation 1. The developer attained the necessary knowledge about Microsoft 365 in general, being able to

make informed architecture decisions. The thought process was written down in the Design Choices Diary.

3.3.3 Prioritized Requirements

The Product Backlog is chosen to record the requirements for its straightforwardness. Microsoft Planner is the tool used to record the Product Backlog, its functionality fully covering the needs of a small development project. Requirements may be prioritized and categorized using a variety of in-built features.

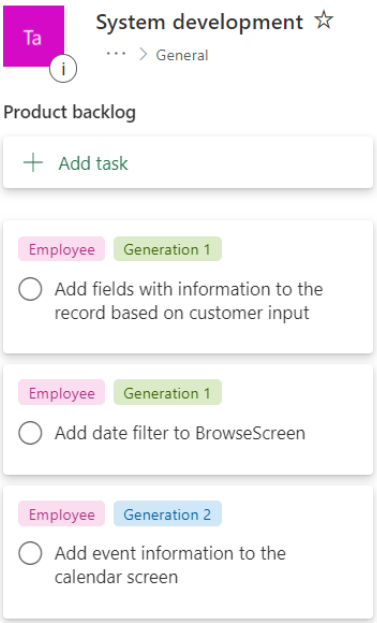


Figure 6 Product backlog in Microsoft Planner (own visualization)

3.3.4 Iteration Modeling and Value

Before the start of each iteration, the requirements from the Product Backlog are considered based on their complexity and priority. After having decided to implement the feature in the current iteration, the feature is moved in Microsoft Planner from the product backlog bucket to the iteration bucket. At the end of each iteration, a fully consumable solution, a new generation should be ready for deployment.

The decision to adhere to delivering a fully consumable solution each iteration was made for the purpose of this thesis since details about the system needed to be noted. Not to write details about the workings of the system just for the sake of the thesis, a decision was made to document continuously and create a few fully consumable, potentially sellable solutions on the way.

3.3.5 Document Continuously and Diary-Driven development

For documentation, the Diary-Driven method is implemented using the Microsoft OneNote tool. A new notebook is created for storing all the information. Individual diaries are

implemented by creating sections named as the diaries, respectively Random Thoughts Diary and Design Choices Diary. Inside of the sections lie the pages. When writing new information either a new page is created or an already existing one is used for recording the information.

At the end of each iteration, a snapshot of the abovementioned diaries is created, serving as documentation for the given generation.

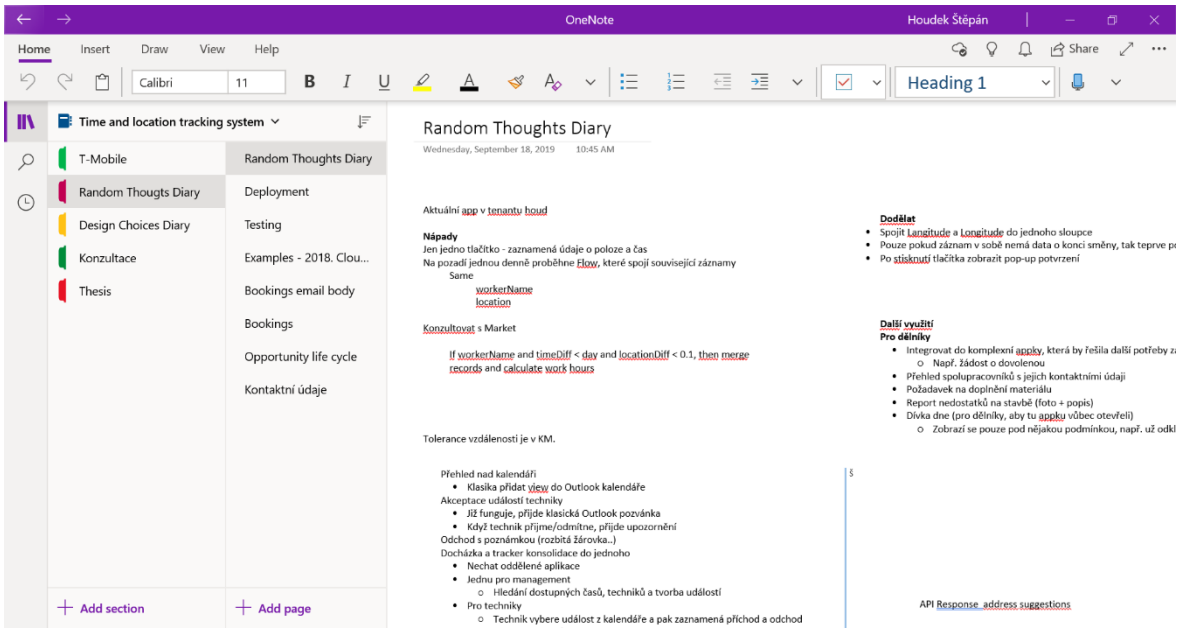


Figure 7 Random thoughts diary in Microsoft OneNote (own visualization)

Concluding, it is possible to use a simple methodology for system development using only tools available in the Microsoft 365 Business Basic license. Microsoft offers a powerful set of tools for work planning and note taking.

4 Development of Magenta Time

The aim of this chapter is to firstly describe the system design choices made, secondly the process of development itself and thirdly a thorough description of the final version of Magenta Time.

4.1 Design choices

Various combinations of design choices are described in the tables below. For the time and location tracking, Power Apps is the only option available in Microsoft 365. For task planning, there are various options available described in tables below. For each part, a degree of suitability for the developed solution score is added. 1 meaning suitable, 0 meaning unsuitable. The scores are summed on the bottom of each table.

The takeaway is that with additional resources such as time and experienced developers, SharePoint online would be better suited for creating a more robust task planning solution. Compared to the Exchange Online events and Microsoft Bookings, there are more options for customizing and tweaking the end-user experience. Considering available resources and its overall highest score, Microsoft Bookings using Exchange online as a data source is a more suitable platform for its ready-made user interface.

Table 3 Design choices comparison – Exchange Online

	Magenta Plan – Power App using EOL Calendar as a data source **Magenta Track – Power App using EOL Calendar as a data source**	**Degree of suitability for the developed solution**
Calendar creation	Each user has their calendar created with their account, there is no need to create a calendar manually	1
Implementation time	This solution uses only ready to use functions. It is possible look for users' available times with an in-built Power Apps function	1
Response time and user-friendliness	The response time is fast since the function needs to query just one calendar, looking for the available times.	1

Custom fields	There is no direct way to add additional fields to Exchange Online events. Requires workarounds using the event 'body' field and manually typing in custom fields. Afterwards text parsing is necessary to extract the custom fields from the event body.	0
Calendar overview	A graphical overview is in-built.	1
Fallback options	If both the employee and task planning Power App stopped working, the Outlook for mobile is still accessible to both view and plan the tasks.	1
Sum		**5**

Table 4 Design choices comparison - SharePoint Calendar

	Magenta Plan – Power App using SharePoint Calendar as a data source **Magenta Track – Power App using SharePoint Calendar as a data source**	
Calendar creation	SharePoint does not out of the box automatically create calendars for new users. Calendars would either need to be created manually or a custom solution would need to be programed to automate the task. Another option would be filtering of one big list with events of all users in the Power App. This would quickly result in slow response time since the volume of records in the list would rise.	0
Implementation time	Solution based on SharePoint Online would require a lot of coding.	0
Response time and user-friendliness	The solution would be potentially slower if not implemented well. On the other hand, after investing a lot of work it would be potentially faster to execute and could be more user-friendly because of more options of customizations.	0
Custom fields	Adding additional fields to a SharePoint list is an in-built feature, making it easy to do so.	1

Calendar overview	There is an in-built way to visualize events of the SharePoint calendar, but it is limited in functionality compared to the Exchange Online Calendar.	0
Fallback options	If the employee application stopped working, there is no in-built fallback option to view the calendar events or plan the tasks.	0
Sum		**1**

Table 5 Design choices comparison - Microsoft Bookings

	Magenta Plan – Microsoft Bookings using EOL Calendar as a data source **Magenta Track – Power App using EOL Calendar as a data source**	
Calendar creation	Each user has their calendar created with their account, there is no need to create calendars manually.	1
Implementation time	Microsoft Bookings can be set-up quickly using a graphical user interface.	1
Response time and user-friendliness	Response time of Microsoft Bookings is fast. Magenta Track responds quickly too since it obtains data just from one user's calendar.	1
Custom fields	Adding additional fields to Microsoft Bookings is an in-built feature, making it easy to do so. To read the custom fields, parsing a chunk of text is required.	1
Calendar overview	A graphical overview well suited for task planning is in-built.	1
Fallback options	If both the employee and task planning Power App stopped working, the Outlook for mobile is still accessible to both view and plan the tasks.	1
Sum		**6**

4.2 Pre-release development generations

Field service management is part of Microsoft's Dynamics 365. Its price is too high for small and medium enterprises. The initial thought of developing Magenta Time came from a senior sales colleague who saw potential in offering a less expensive solution, potentially increasing sales of the Microsoft 365 licenses. Based on his input an initial product backlog was put together and a first proof of concept system was developed, the Generation 0.

4.2.1 Generation 0

Generation 0 consists of two separate applications. The task planning is meant to be used by the company managers who distribute work among the employees. The features include user directory search, location services, employees' calendar search and event creation and assignment to employees. The time and location tracking application is meant to be used by employees, for example technicians who travel from one household to another, fixing broken equipment. The features include reading and viewing the employees' calendar, recording start and end of work to a SharePoint list with details such as the GPS location and time and viewing recorded work tasks. Below you may see the initial screen of the task planning application where the manager assigning work selects to which company's employee the task is assigned and writes down basic details.

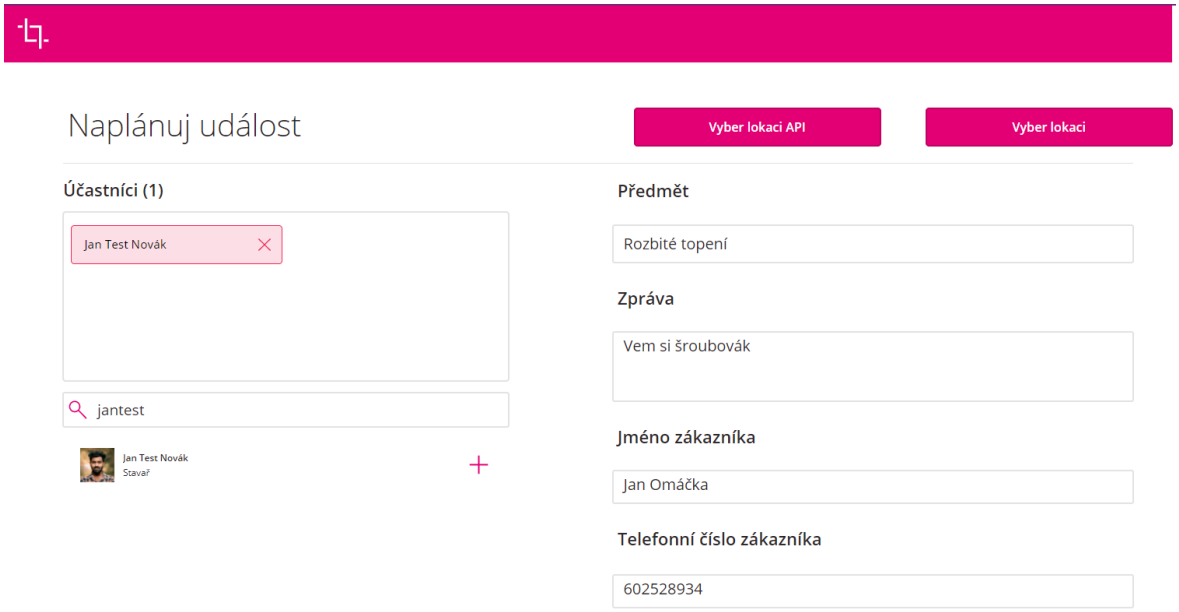


Figure 8 First screen of the task planning application (own visualization)

4.2.2 Generation 1

For marketing purposes, the whole system is called "Magenta Time", the task planning application "Magenta Plan" and the time and location tracking application "Magenta Track". The term Magenta is used since it is the dominant color connected to T-Mobile.

After approval of the Generation 0 by the abovementioned senior colleague, Magenta Time was presented to sales representatives who found a suitable pilot customer. The pilot customer was then asked to provide feedback and propose new requirements based on which the Product Backlog was updated. The main issue was that the Power Apps function which the application relied on for finding available calendar times took too long to execute and was not suitable for assigning tasks to more than one person.

Architecture Envisioning ensued, during which a new platform was chosen, Microsoft Bookings for Magenta Plan. Product Backlog was updated again, including tasks connected with the change of architecture. The Microsoft Bookings site was created. Improvements for Magenta Track included modifying it to accept output of Microsoft Bookings, introducing offline mode, an option to save a note with each record, various bug fixes and optimizing the application response time. The new development iteration was started at the end producing Generation 1 which was implemented for the pilot customer. Two new features were requested – firstly, a way for the managers to create new service requests which are not time bound and a way for technicians to view these tasks in a so-called task auction screen. Secondly, an option to upload attachments with the records. Below you may see the screen of Magenta Plan where the manager assigning work is able to view availability of the company's employees.

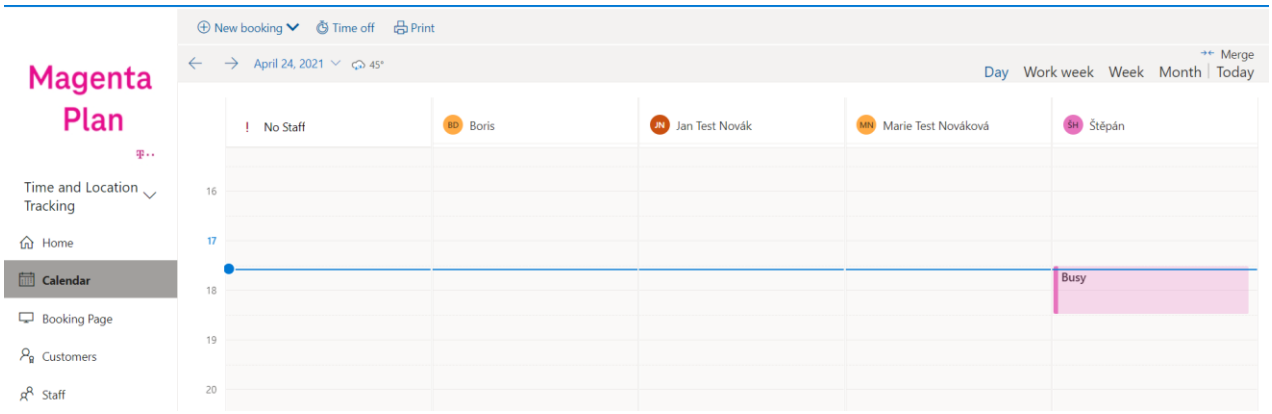


Figure 9 Magenta Plan calendar overview (own visualization)

4.3 First release generation

Having collected requests for new features, next development cycle starts, adding the features to the product backlog and following the same structure as in the first cycle. At the end Generation 2 is ready. Generation 2 is offered for free to the pilot customer and as a paid product to the general public. Options of future development are outside the scope of this paper.

Below the use case scenarios for Generation 2 are described. For Magenta Track, both the use case diagram and scenarios are created. For Magenta Time and the underlying SharePoint storage only the use case diagrams are created, omitting detailed descriptions of the use case scenarios since the names of the use-cases serve as sufficient explanation of their purpose.

4.3.1 Magenta Track

The use case diagram for Magenta Track is shown below. Details of individual use cases are further described.

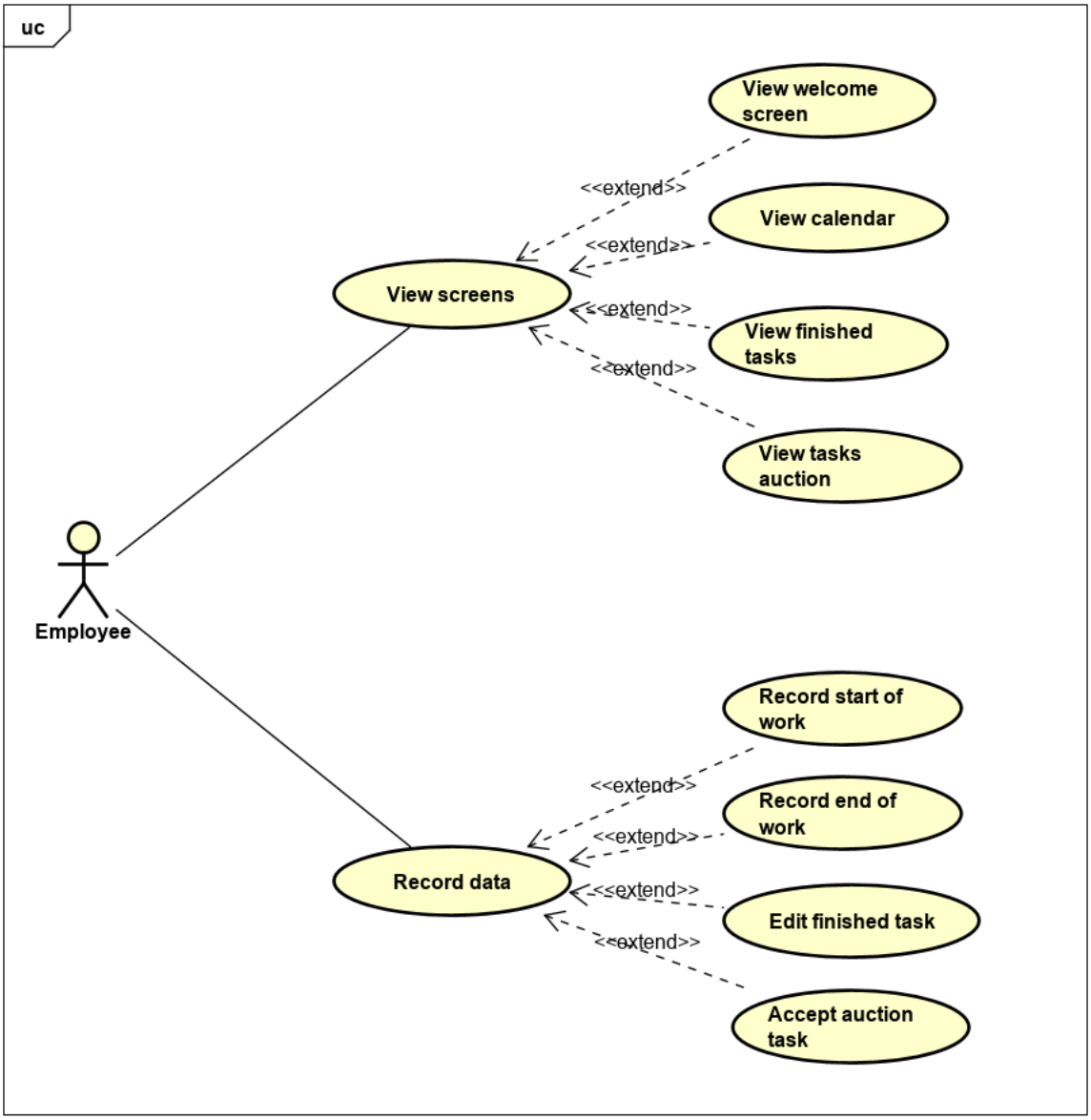


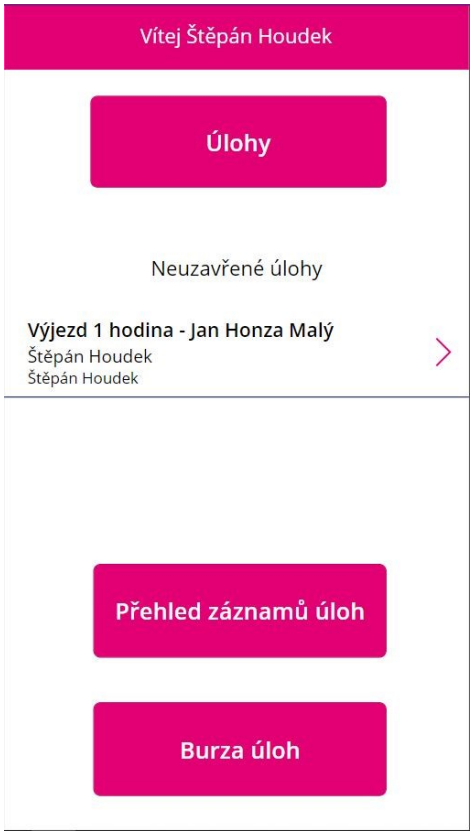
Figure 10 Magenta Track use case diagram (own visualization)

View welcome screen

The employee opens the application and chooses the required action from the menu.

Table 6 UA1 - Welcome Screen

Use case name	**View welcome screen**

Use case ID	UA1
Use case goal	Choosing a desired action
UUID	Welcome screen 
Primary actor(s)	Employee reporting work
Secondary actor(s)	-
Entry requirements	Employee is logged in Power Apps
Basic scenario	

Step	**Role**	**Action**

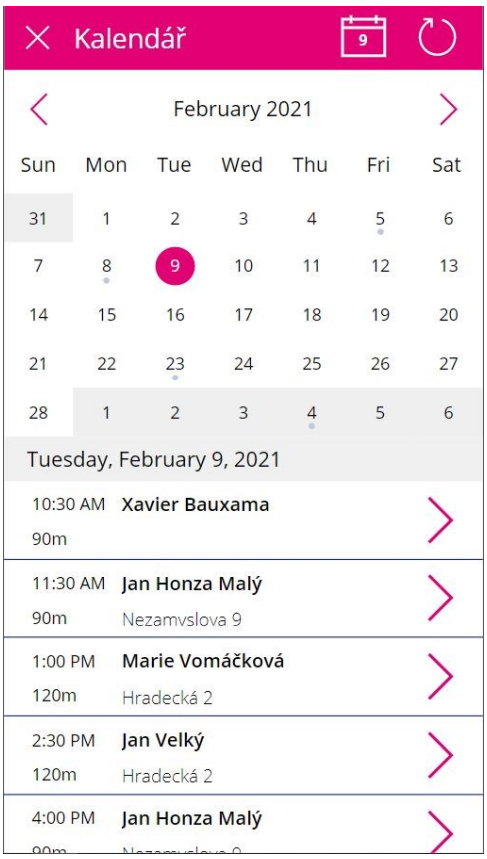
<table>
<tr><td></td><td><table><tr><td>1</td><td>Employee</td><td>Opens the app and chooses one of the following actions:<ul><li>calendar</li><li>finish task</li><li>view finished tasks</li><li>view tasks auction</li></ul></td></tr></table></td></tr>
<tr><td>Alternative scenario</td><td><table><tr><th>Step</th><th>Role</th><th>User</th></tr><tr><td>1a1</td><td>Employee</td><td>Closes the app</td></tr></table></td></tr>
</table>

View calendar

The employee opens the finished tasks screen and views all records created by themselves.

Table 7 UA2 – View calendar

Use case name	**View calendar**
Use case ID	UA2
UUID	Calendar browse screen

<table>
<tr><td></td><td> 
</td></tr>
<tr><td>Use case goal</td><td>View calendar</td></tr>
<tr><td>Primary actor(s)</td><td>Employee reporting work</td></tr>
<tr><td>Secondary actor(s)</td><td>-</td></tr>
<tr><td>Entry requirements</td><td>UA1. Employee chose the “Calendar” action.</td></tr>
<tr><td>Basic scenario</td><td>
<table>
<tr><th>Step</th><th>Role</th><th>Action</th></tr>
<tr><td>1</td><td>Application</td><td>Tasks are loaded into the calendar browse screen</td></tr>
<tr><td>2</td><td>Employee</td><td>Looks at the calendar tasks</td></tr>
</table>
</td></tr>
</table>

Record start of work

The employee checks their calendar, chooses an event, and creates a new start of work record.

Table 8 UA3 – Record start of work

Use case name	Record start of work
Use case ID	UA3
UUID	Edit arrival screen
Use case goal	Recording start of work
Primary actor(s)	Employee reporting work

Secondary actor(s)	-
Entry requirements	View calendarUA2
Basic scenario	

Step	Role	Action
1	Employee	Employee chooses a calendar event and selects it
2	Application	Create new record screen is displayed
3	Employee	Employee selects the start of work button
4	Application	Saves data pertaining to start of work to a local collection
5	Application	Navigates to welcome screen

Alternative scenario

Step	Role	Action
1a1	Employee	Employee chooses navigation button which redirects him/her to a GPS navigation application
1a2	Employee	After having arrived, employee opens Magenta Track
1a3	Employee	Employee continues with the UA1 use case scenario

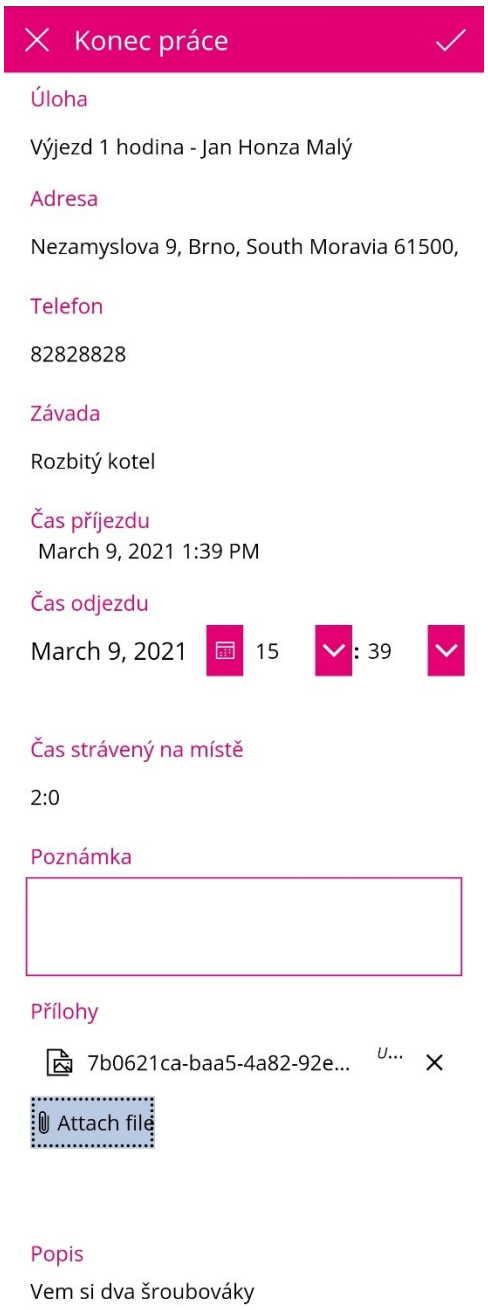
	<table><tr><th>Step</th><th>Role</th><th>User</th></tr><tr><td>1b1</td><td>Employee</td><td>Employee chooses phone button which redirects them to a phone application</td></tr><tr><td>1b2</td><td>Employee</td><td>After having finished the call, employee opens Magenta Track</td></tr><tr><td>1b3</td><td>Employee</td><td>Employee continues with the UA1 use case scenario</td></tr></table>

Record end of work

The employee opens the app and on the welcome screen selects the record with the “open” status. The edit screen of that records opens. Employee records end of work.

Table 9 UA4 - Recording end of work

Use case name	**Record end of work**
Use case ID	UA4
UUID	Edit departure screen

	
Use case goal	Recording end of work
Primary actor(s)	Employee reporting work
Secondary actor(s)	-

Entry requirements	UA3
Basic scenario	

Step	Role	Action
1	Employee	Employee selects the record with the "open" status on the welcome screen
2	Application	Displays the edit record screen
3	Employee	Records end of work
4	Application	Writes data to SharePoint including start of work information
5	Application	Navigates to welcome screen

Alternative scenario

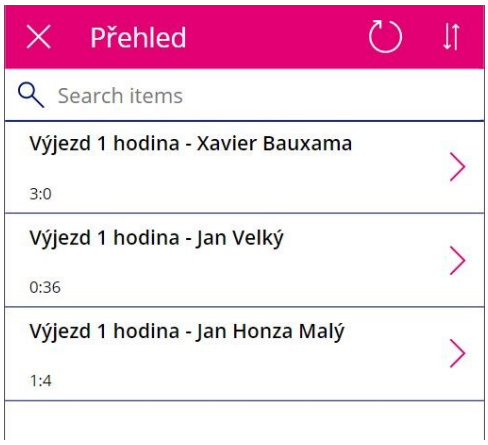
Step	Role	User
4a1	Application	If the device is offline, the local collection created in UA3 is updated with departure information
4a2	Application	Continues with step 5

View finished tasks

The employee opens the finished tasks screen and views all records created by themselves.

Table 10 UA5 - View finished tasks

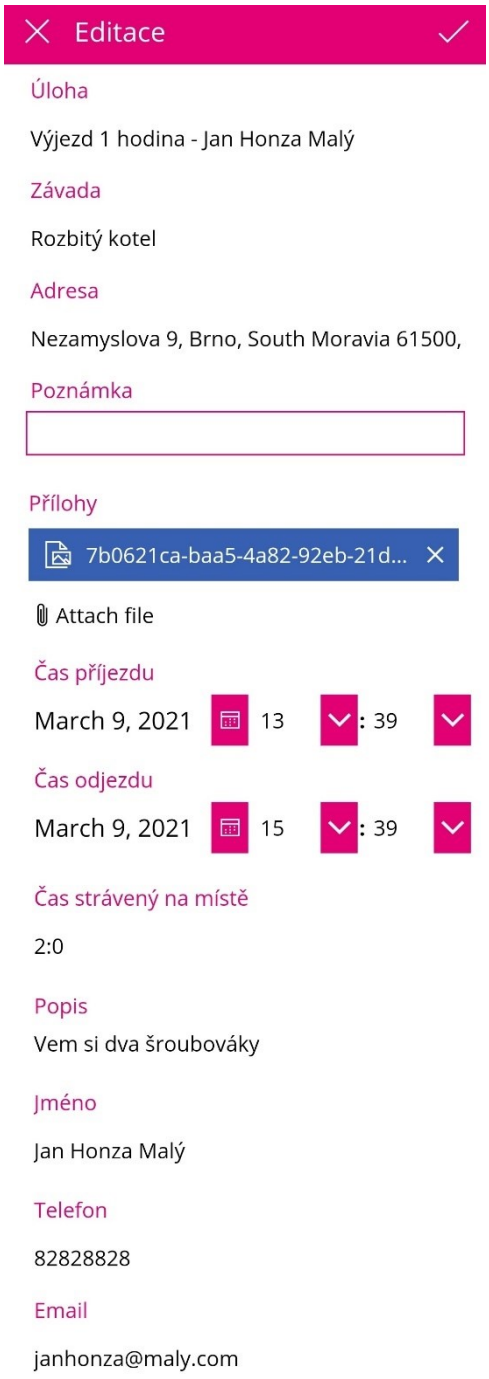
Use case name	**View finished tasks**

<table>
<tr><td>Use case ID</td><td>UA5</td></tr>
<tr><td>UUID</td><td>Finished tasks browse screen
 
</td></tr>
<tr><td>Use case goal</td><td>View finished tasks</td></tr>
<tr><td>Primary actor(s)</td><td>Employee reporting work</td></tr>
<tr><td>Secondary actor(s)</td><td>-</td></tr>
<tr><td>Entry requirements</td><td>UA1. Employee chose the “View finished tasks” action.</td></tr>
<tr><td>Basic scenario</td><td>
<table>
<tr><th>Step</th><th>Role</th><th>Action</th></tr>
<tr><td>1</td><td>Application</td><td>Finished tasks are loaded into the finished tasks browse screen</td></tr>
<tr><td>2</td><td>Employee</td><td>Looks at the tasks</td></tr>
</table>
</td></tr>
</table>

Edit finished task

The employee opens a finished task and updates the record.

Table 11 UA6 – Edit finished task

Use case name	**Edit finished task**
Use case ID	UA6
UUID	Edit record screen 
Use case goal	Edit finished task

Primary actor(s)	Employee reporting work
Secondary actor(s)	-
Entry requirements	UA5. Employee is online.
Basic scenario	

Step	Role	Action
1	Employee	Chooses a record on the finished tasks screen
2	Application	Opens the edit screen and loads the record
3	Employee	Edits the record and clicks on the save icon
4	Application	Uploads the changes to SharePoint
5	Application	Navigates back to browse screen

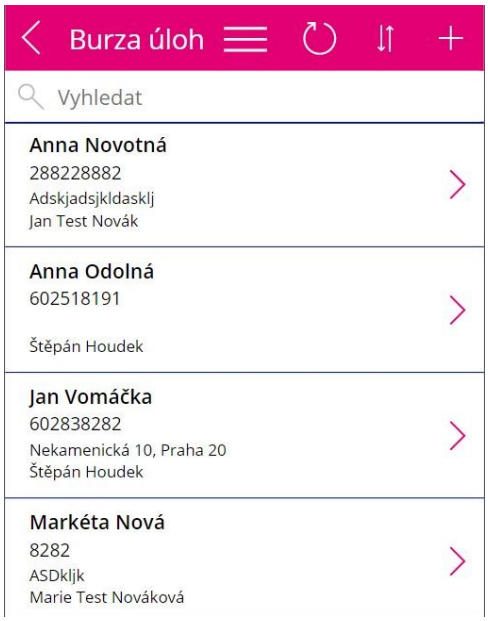
Alternative scenario

Step	Role	User
3a1	Employee	Chooses not to edit the record and clicks on the cancel button
3a2	Application	Navigates back to browse screen

View tasks auction

The Employee opens the tasks auction screen and views available tasks.

Table 12 UA7 – View tasks auction

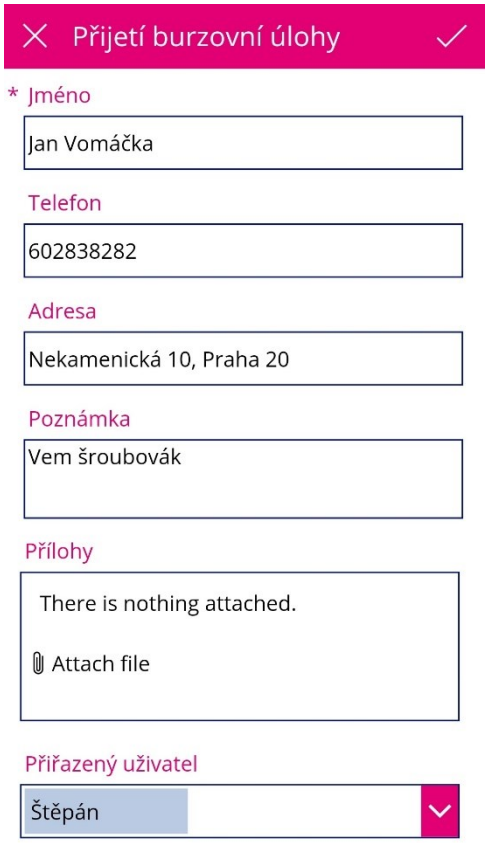
Use case name	**View tasks auction**
Use case ID	UA7
UUID	Auction browse screen 
Use case goal	View tasks auction
Primary actor(s)	Employee reporting work
Secondary actor(s)	-
Entry requirements	UA1. Employee chose the “View tasks auction” option and is online.
Basic scenario	

Step	Role	Action
1	Application	Available tasks are loaded into the task auction screen
2	Employee	Looks at the auction tasks

Accept auction task

The employee chooses an auction task and assigns it to themselves.

Table 13 UA8 - Accept auction task

Use case name	**Accept auction task**
Use case ID	UA8
UUID	Edit auction screen 
Use case goal	Assign auction task
Primary actor(s)	Employee reporting work
Secondary actor(s)	-

<table>
<tr><td>Entry requirements</td><td>UA7. Employee chose an auction task and is online.</td></tr>
<tr><td>Basic scenario</td><td>
<table>
<tr><th>Step</th><th>Role</th><th>Action</th></tr>
<tr><td>1</td><td>Application</td><td>The auction task is loaded into an edit screen</td></tr>
<tr><td>2</td><td>Employee</td><td>Chooses to whom the auction task will be assigned to. Default value is the employee themselves.</td></tr>
<tr><td>3</td><td>Employee</td><td>Clicks on the save button</td></tr>
<tr><td>4</td><td>Application</td><td>Saves the assignment information to SharePoint</td></tr>
</table>
</td></tr>
<tr><td>Alternative scenario</td><td>
<table>
<tr><th>Step</th><th>Role</th><th>Action</th></tr>
<tr><td>2a1</td><td>Employee</td><td>Edits the task information</td></tr>
<tr><td>2a2</td><td>Employee</td><td>Continues with step 3</td></tr>
</table>
<table>
<tr><th>Step</th><th>Role</th><th>Action</th></tr>
<tr><td>2a1</td><td>Employee</td><td>Employee chooses not to accept the auction task and clicks on the cancel button</td></tr>
<tr><td>2a2</td><td>Application</td><td>Navigates back to the tasks auction screen</td></tr>
</table>
</td></tr>
</table>

4.3.2 Magenta Plan

Microsoft Bookings is used for Magenta Plan in Generation 2. The managers may create service tasks in a user-friendly interface, see Figure 9.

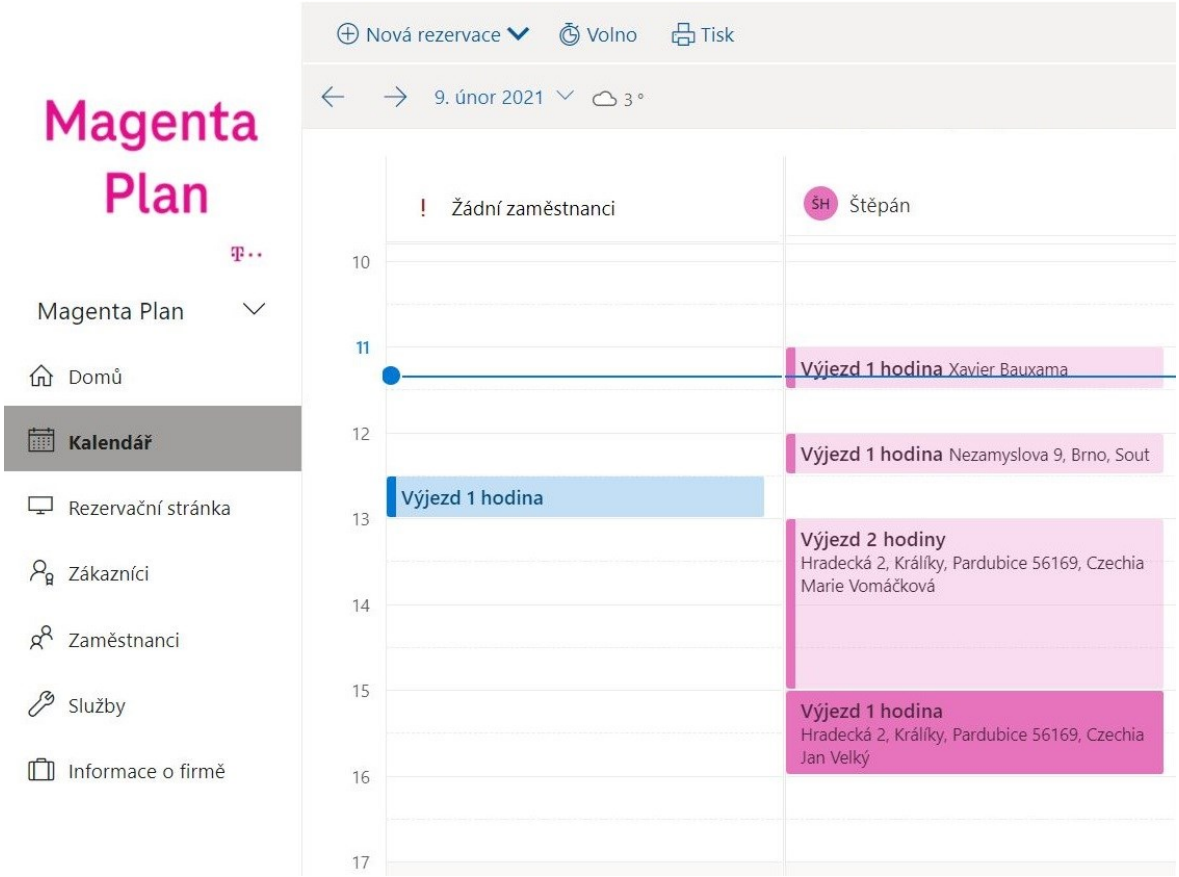


Figure 11 Magenta Plan task planning (own visualization)

For Magenta Plan, only the use case diagram was created since the names of the use-cases serve as sufficient explanation of their purpose. The use cases may be divided into four categories as seen below – managing service requests, managing staff, managing customers, and editing business information.

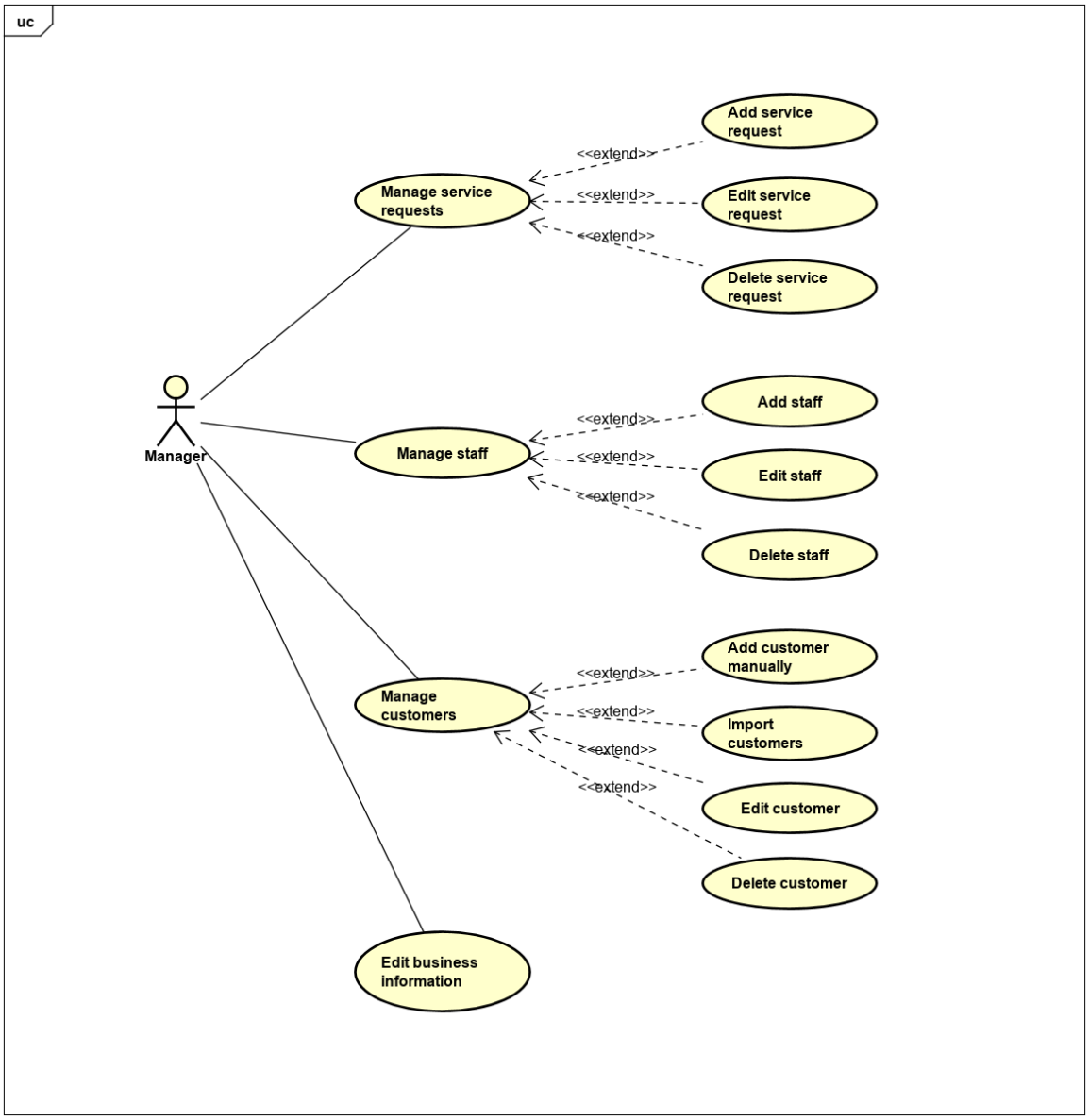


Figure 12 Magenta Plan use case diagram (own visualization)

4.3.3 SharePoint data storage

The underlying data storage is a SharePoint list. SharePoint comes bundled with the Microsoft 365 Business Basic package. When a company buys a single license, it automatically obtains 1 TB of storage. Then, with each additional license bought 10 GB is added to the storage pool. Magenta Time is unlikely to reach Share point's storage limits. One list may contain up to 30 million records. Attachments will mostly use the available storage. With an average attachments size of 3 MB, the SharePoint storage limit would be depleted after having uploaded 333 333 attachments (Microsoft authors 2021a). An overview of the list's structure may be seen below:

Table 14 Overview of the SharePoint list structure

Field name	**Data type**	**Field name**	**Data Type**
taskStr	Single line of text	customerAddressStr	Single line of text
employeeNameStr	Single line of text	customerNoteStr	Multiple lines of text
locationStr	Single line of text	latitudInt	Number
customerIssueStr	Multiple lines of text	longitudInt	Number
durationStr	Single line of text	latitudEndInt	Number
durationInt	Number	longitudEntInt	Number
arrivalTimeDT	Date and time	recordedOfflineBool	Boolean
departureTimeDT	Date and time	recordedOfflineEndBool	Boolean
statusStr	Single line of text	ID	Number
workerNoteStr	Multiple lines of text	eventIDStr	Multiple lines of text
editedManuallyBool	Boolean	Created	Date and time
customerNameStr	Single line of text	Created By	Person

customerEmailStr	Single line of text	Modified	Date and Time
customerPhoneStr	Single line of text	Modified By	Person

For the SharePoint data source, only the use case diagram was created since the names of the use cases also describe the functionality. The use cases may be divided into three categories as seen below – managing work records, managing tasks auction, and exporting work records.

Figure 13 Data source use case diagram (own visualization)

4.4 Deployment of Magenta Time

There are two approaches to deploying Magenta Time from the development environment to the customer. The first one is manual, not using any automation but copy paste, which may be slow and prone to error caused by human potential for inaccuracy. The second approach is to automate as much of the deployment as possible which initially requires time but makes the deployment faster.

The following parts need to be deployed:

- Power App – Magenta Track,
- SharePoint list – data source for Magenta Track,
- Bookings – Magenta Plan.

Automating Bookings and Power App deployment would require a considerable amount of effort; thus, both are deployed manually, deployment to one customer taking around 20 minutes. Enabling Magenta Plan requires creating the company in the Bookings portal and setting up necessary fields. The Magenta Track is exported and imported, requiring a change of data source after import but otherwise being a ready to use solution.

Currently, only the SharePoint list and permissions deployment is automated using PowerShell. Manually copying all the columns is a long and error-prone process, taking up approximately twenty minutes. Automating the process takes around an hour with the potential of re-using the code to deploy other SharePoint lists. Firstly, the script exports the SharePoint list in an XML format. Secondly, the list is deployed into the target environment. Thirdly, the permission levels and groups are created. Afterwards, the administrator needs to manually add user accounts into the permission groups.

5 Pilot customer evaluation

Firstly, the state of field service management of the pilot customer before Magenta Time is described. Secondly, the pilot customer's feedback is described.

5.1 State before Magenta Time

Before Magenta Time, only pen and paper were used for FSM. Smartphones were used only to communicate via SMS or phone calls. Service tasks were recorded in a large paper calendar, see figure 10. Tasks without assigned time were written on a piece of paper and laid on top of the calendar. Every morning the technicians would come to the company's premises and look at the calendar to find out which tasks were assigned to them. Technicians did not record all service visits, only the last one at the customer's site where a service sheet was filled in, see figure 10.

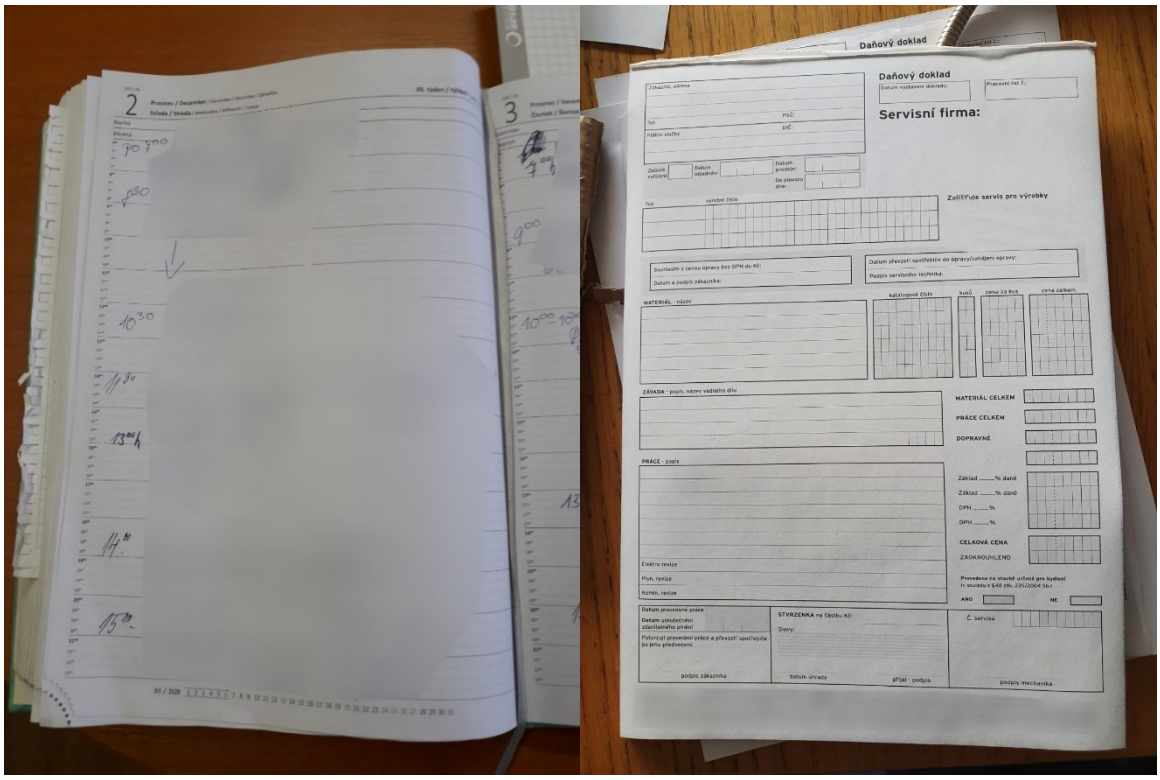


Figure 14 Pilot customer's calendar and service sheet (Pilot customer)

5.2 Pilot customer feedback

The use of Expectancy Disconfirmation model inspired by Oo et al. (2018) combined with a qualitative interview was used to evaluate whether Magenta Time satisfies the pilot

customer's needs. Since the pilot company is a small one, only two users evaluated the system. Each user represents one user group, specifically user 1 is a manager and evaluated Magenta Plan, user 2 is a technician and evaluated Magenta Track. The answers to non-qualitative questions were given using a Likert scale (5-point scale). The levels of the scale are as follows.

- level 5 = strongly agree
- level 4 = agree
- level 3 = uncertain
- level 2 = disagree
- level 1 = strongly disagree

5.2.1 User 1

Firstly, questions about the profile of the employee were asked. He is 33 years old and evaluates his knowledge of modern technologies as intermediate. He plans and assigns work using Magenta Time.

Secondly, the qualitative questions were asked. Answers to the questions may be found below.

- How do you overall evaluate the switch from previous state of planning work to Magenta Plan?
    - Unexpectedly very positively.
- What are the main benefits of switching to Magenta Plan?
    - Switching from paper and pen to digital.
    - Higher flexibility of planning and better synchronization between work planners and technicians.
    - Everyone can assign work, even technicians.
    - Better overview of work since all records are stored in a unified format.
    - Truly everyone involved in the process of planning and assigning work uses the application. No-one expressed the desire to stick to the old system.
- What are the main disadvantages of switching to Magenta Plan?
    - Multiple applications are required to run the whole Magenta Time system. The system is not unified in one interface.

Thirdly, the user 1 filled in the questionnaire with statements about Magenta Plan, results of which may be found below.

Questions	Answers
Navigation	
1. Navigating to individual pages is easy	5
2. It is clear where navigation buttons lead to	5

Ease of use		
1.	Application loads fast	5
2.	Individual pages load fast	5
3.	New tasks save fast	5
4.	New tasks are always correctly saved	5
Design		
1.	The application's design is attractive	4
2.	The text size is easy to read	5
3.	The application's screens and elements are structured in a meaningful way	4
4.	The application's element layout is easy to learn and understand	4

5.2.2 User 2

Firstly, questions about the profile of the employee were asked. He is 25 years old and evaluates his knowledge of modern technologies as intermediate. He records work using Magenta Track.

Secondly, the qualitative questions were asked. Answers to the questions may be found below.

What are the main benefits of switching to Magenta Track compared to the previous system of tracking work?

- It saves time since in the morning I do not have to go to the office to pick up a piece of paper with the day's tasks.
- I sometimes lost the piece of paper with day's tasks. I am less likely to lose my phone.
- I can see new work tasks immediately.
- My boss sees right away when I record a work task.

What are the main disadvantages of switching to Magenta Track?

- Taping on the system back button does not navigate to previous screen as expected but closes Magenta Track.

Thirdly, the user 2 filled in the questionnaire with statements about Magenta Track, results of which may be found below.

Questions	Answers
Navigation	
1. Navigating to individual pages is easy	5
2. Navigating back to home screen from all screens is easy	3
3. It is clear where navigation buttons lead to	5
Ease of use	
1. Application loads fast	5
2. Individual pages load fast	5
3. New tasks save fast	5
4. Recorded tasks are always correctly saved	Unapplicable[1]
Design	
1. The application's design is attractive	5
2. The text size is easy to read	5
3. The application's screens and elements are structured in a meaningful way	5
4. The application's element layout is easy to learn and understand	5

[1] The user has not checked whether recorded tasks are saved correctly.

6 Comparison of available solutions

The aim of this chapter is to perform a comparison of solutions available on the Czech market with a focus on system features and its price.

Google query "systém plánování servisních výjezdů" was used to identify companies having developed a FSM system in Czechia. The language of the query is Czech since the Magenta Time system will be offered mainly on the Czech market. As relevant results were considered solutions offered on the first page of the search result excluding advertisements. Furthermore, the solution offered by the company had to be intended for use on mobile devices. Three companies were obtained by the abovementioned Google search. The features of individual products were collected on the companies' websites or by email inquiry. The names of the companies are not revealed for purposes of anonymization since some information is not publicly available.

	Company 1	**Company 2**	**Company 3**	**Magenta Time**
1. System model				
a. Cloud	x	x	x	x
b. Private-Cloud	x		x	
c. On-premises	x		x	
2. Mobile platform				
a. Android	x	x	x	x
b. iOS	x		x	x
c. Windows Phone	x		x	x
3. Offline mode available to technicians		x	x	x
4. Self-service client portal	x	x		x
5. Client notification after a job is created	x	x	x	x

6. Mobile stock and material overview	x	x		
7. GPS location record	x	x	x	x
8. Field technician route optimalization	x	x		
9. Electronic service sheet	x	x	x	
10. Accounting software integration	x	x	x	
11. Option to edit job parameters by technicians		x	x	x
12. Saving photos	x	x	x	x
13. Monthly fee for 25 technicians	12 250 CZK	?	9 975 CZK	See below

6.1 Company 1

Company 1 offers a customer relationship management (CRM) solution in which the management of service requests is implemented and fully integrated, enabling seamless transfer of customer data between all the internal CRM parts. It offers a robust set of functions with support of three different types of deployment – cloud, private-cloud, and on-premises. On top of that, the major mobile phone operating systems are supported, specifically Android, iOS, and Windows Phone. The downsides are the unavailability of an offline mode and its high monthly fee caused by the need to buy the whole CRM solution.

6.2 Company 2

The offer of company 2 is a standalone system for management of service requests. Compared to company 1 and 2 it lacks support of other mobile operating systems than Android and is run only in the company 2's cloud. On the other hand, the system itself offers the widest set of features of all, for example and offline mode available for record creation and a self-service portal for customers. The price was not revealed by the company.

6.3 Company 3

Same as company 2, company 3 offers a standalone system for service request management. Compared to the other two companies, the list of features offered by the system is the smallest, lacking for example the mobile stock and material overview and the optimalization of field technicians' route. The price is smaller than in the case of company 1.

6.4 Magenta Time

Magenta Time lacks in features compared to all three above-mentioned solutions. Its main strength is its low price. There is a onetime implementation price of 10 000 CZK for the SME market and a monthly cost equal to the price of the Microsoft 365 licenses, approximately 2 300 CZK for 25 employees. When a company would adopt Magenta Time for two years, its monthly cost for 25 employees would be approximately 600 CZK.

6.5 Worldwide available solutions

Solutions available in the English language were identified using a Google search „field service management system". Two of the results were picked and analyzed for additional features not available on the Czech market. Both Jobber (2021) and Codefied Inc. (2021) offer continuous GPS tracking. As Česká pošta was fined for continuously tracking the employees' location in 2013, the two aforementioned features might not be legal in Czechia (Česká televize 2013). Another feature with the potential of generating revenue is the credit card processing, allowing the companies to use a portable card reader to receive payments. The option of online payments is also included. Chat is made available for employees to exchange work-related information in real time.

Conclusions

The aim of this bachelor thesis was to assess the feasibility of development and implementation of a field service management system financially accessible to small and medium enterprises and to test the hypothesis that a small enterprise will accept such system. The system is developed by a non-developer using tools available in Microsoft 365. To evaluate the fulfillment of the aim of the thesis, a brief description of all its parts follow.

In the first chapter, the FSM field and the history of time and location tracking were presented. Few articles were found on the topic of field technicians work planning and dispatching. A considerably larger pool of knowledge is available about time and location tracking. Inspiration was drawn from scholars mentioned in this chapter, mainly the options of future development such as implementing AI or advanced ways of authentication.

In the second chapter, the parts of the Microsoft 365 package used for documentation, development planning and development were outlined and their features important for the development of Magenta Time were detailed. Specifically, Microsoft SharePoint Online, Power Apps, Microsoft Bookings and Microsoft OneNote were included in the chapter.

In the third chapter, the methodology adopted was presented and its practical implementation demonstrated. Development of the system was formalized by using some practices of the Agile Modeling methodology. Documentation was be created using the Diary-Driven Development approach. For adhering to the methodology tools were needed. Microsoft 365 includes tools for planning the development and writing down documentation which were found suitable for a small project. Neither OneNote's nor Planner's main aim is to support system development, but they sufficed. Planner is meant for coordination of teams, but it was possible to effectively keep an overview of a one's own tasks. OneNote's strength, as the name suggests is note taking, but it served well for keeping documentation and it was possible to maintain a clear documentation structure.

The fourth chapter deals with the development of the system. All tools needed for the purposes of the Magenta Time system were available in the Microsoft 365 package which was found suitable for development of such a system. Specifically, Power Apps was used for development of the Magenta Track application for tracking work. Secondly, Microsoft SharePoint served as a data storage for the work records. Thirdly, Magenta Plan was based on Microsoft Planner, handling the work task planning and assignment. It was difficult to integrate Microsoft Planner with Power Apps, requiring non-conventional and non-supported ways of connecting them though at the end it was possible to overcome these obstacles.

The subsequent fifth chapter shows the evaluation results of the Magenta Time by the pilot customer. Concluding from the feedback collected, the experience with Magenta Time is very positive and confirms the thesis hypothesis. Both users evaluate the switch from the previous service request planning and tracking system as a significant improvement. However, the application was deployed to only one company and the sample of users collected was too small to obtain valid evaluation results. This may be remediated later

when Magenta Time will have been sold to other companies. An option of collecting feedback for Magenta Track would be to implement the questionnaire into the application itself. After a pre-defined number of recorded tasks, the users would be asked to fill in the questionnaire.

Lastly, the sixth chapter compares solutions available both on the Czech market and worldwide. Magenta Time offers two main benefits compared to available solutions. It is built using Power Apps, SharePoint and Bookings which are all an integral part of Microsoft 365, making integration such as displaying and interacting with work events across individual applications or single sign on easy. On top of that, its monthly price is significantly lower than the price of its competitors, an important aspect for the SME market. When a company uses Microsoft 365 services such as Exchange online or is considering adopting it, the monthly license cost is distributed among all the utilized services. Bearing that in mind, Magenta Time lacks in features such as an electronic service sheet compared to the already available solutions.

Magenta Time is a solution for small companies who do not want to invest a lot of money into a FSM management system since its price is the lowest of all compared solutions. Thus, the main competitive advantage of Magenta Time is its integration with Microsoft 365 and its low price.

Glossary

Term	Abbreviation	Meaning
Agile Modeling		Agile Modeling is a practice-based methodology for modelling and documentation of software systems (Ambler 2020).
Application Programming Interface	API	An Application Programming Interface is an interface that provides programmatic access to service functionality and data within an application or a database (Gartner 2021).
Artificial Intelligence	AI	Artificial Intelligence applies advanced analysis and logic-based techniques, including machine learning, to interpret events, support and automate decisions, and take actions (Gartner 2021a).
Diary-driven Development		Diary-driven development is a "just-sufficiently-formal" approach to creating software documentation (Dent et al. 2008).
Field Service Management	FSM	Field Service Management includes the detection of a field service need, field technician scheduling and optimization, dispatching, parts information delivery to the field, and process support of field technician interactions (Gartner 2021b).
Magenta Plan		Magenta Plan is a configured page of Microsoft Bookings which server for field technician scheduling (author).
Magenta Time		Magenta Time is an umbrella term for Magenta Plan and Magenta Track (author).
Magenta Track		Magenta Track is a Power App application for tracking and supporting the work of field technicians (author).

Microsoft 365	Microsoft 365 is the productivity cloud presenting a wide array of services to businesses (author).
Microsoft Bookings	Microsoft Bookings is a scheduling tool allowing business to setup both an internal and external facing interface for managing booking of services (author).
Microsoft OneNote	Microsoft OneNote is a digital note taking application offering user interface like a classical paper notebook (author).
Microsoft Planner	Microsoft Planner is a Kanban solution offering a way of organizing teamwork and tasks (author).
Microsoft SharePoint	Microsoft SharePoint is a web-based collaborative platform used for creating both internal and external facing sites (author).
Power Apps	Power Apps is a platform enabling users to create both simple and complex applications with little to no code (author).
Small and medium SME enterprises	Small and medium enterprises are enterprises with headcount below 250 and turnover below 50 million Euro or balance sheet total below 43 million Euro (European Commission 2003).

List of references

AGNIHOTHRI, Saligrama, Nagaraj SIVASUBRAMANIAM and Donald SIMMONS, 2002. Leveraging technology to improve field service. *International Journal of Service Industry Management*.

AMBLER, Scott, 2020. Agile Modeling (AM) Home Page: Effective Practices for Modeling and Documentation. *Agile Modeling (AM)* [online] [accessed 2020-12-10]. Available at: http://agilemodeling.com/

ARSENOVIC, Marko, Srdjan SLADOJEVIC, Andras ANDERLA and Darko STEFANOVIC, 2017. FaceTime—Deep learning based face recognition attendance system. In: *2017 IEEE 15th International Symposium on Intelligent Systems and Informatics (SISY)*. B.m.: IEEE, p. 000053–000058.

ČESKÁ TELEVIZE, 2013. Za sledování doručovatelek dostala pošta pokutu 80 tisíc. *ČT24 - Nejdůvěryhodnější zpravodajský web v ČR - Česká televize* [online] [accessed 2021-02-09]. Available at: https://ct24.ceskatelevize.cz/domaci/1084315-za-sledovani-dorucovatelek-dostala-posta-pokutu-80-tisic

CODEFIED INC., 2021. *Housecall Pro - #1 Field Service Management Software & App* [online] [accessed 2021-02-19]. Available at: https://www.housecallpro.com/

COMPUTER, Express, 2020. Mphasis implements Microsoft's Power Apps to keep its employees safe and productive during the pandemic. *Express Computer* [online]. Available at: https://search-proquest-com.zdroje.vse.cz/docview/2410091917?accountid=17203

CORDEAU, Jean-François, Gilbert LAPORTE, Federico PASIN and Stefan ROPKE, 2010. Scheduling technicians and tasks in a telecommunications company. *Journal of Scheduling*. **13**(4), 393–409.

DENT, Andrew, Ashley AITKEN, Sonya ROSBOTHAM, and OTHERS, 2008. From Scrum to Solo: How Small is Too Small a Team to Still Call it Software Engineering? In: *19th Australian Software Engineering Conference: ASWEC 2008; Experience Report Proceedings*. B.m.: Engineers Australia, p. 152.

EUROPEAN COMMISSION, 2003. *SME definition | Internal Market, Industry, Entrepreneurship and SMEs* [online] [accessed 2021-02-09]. Available at: https://ec.europa.eu/growth/smes/sme-definition_en

EUROPEAN COMMISSION, 2020. Digital Economy and Society Index (DESI) 2020. *Shaping Europe's digital future - European Commission* [online] [accessed 2021-01-20]. Available at: https://ec.europa.eu/digital-single-market/en/scoreboard/czech-republic

GARTNER, 2019. *Gartner Forecasts Worldwide Public Cloud Revenue to Grow 17% in 2020* [online]. 13. September 2019. Available at: https://www.gartner.com/en/newsroom/press-releases/2019-11-13-gartner-forecasts-worldwide-public-cloud-revenue-to-grow-17-percent-in-2020

GARTNER, 2021. Definition of Application Programming Interface (API) - Gartner Information Technology Glossary. *Gartner* [online] [accessed 2021-04-25]. Available

at: https://www.gartner.com/en/information-technology/glossary/application-programming-interface

GARTNER, 2021a. Definition of Artificial Intelligence (AI) - Gartner Information Technology Glossary. *Gartner* [online] [accessed 2021-04-25]. Available at: https://www.gartner.com/en/information-technology/glossary/artificial-intelligence

GARTNER, 2021b. Definition of Field Service Management - Gartner Information Technology Glossary. *Gartner* [online] [accessed 2021-04-25]. Available at: https://www.gartner.com/en/information-technology/glossary/field-service-management

GARTNER, 2021c. Definition of Software as a Service (SaaS) - Gartner Information Technology Glossary. *Gartner* [online] [accessed 2021-01-20]. Available at: https://www.gartner.com/en/information-technology/glossary/software-as-a-service-saas

GARTNER, 2021d. Field Service Scheduling & Management (FSM) Software Reviews 2021 | Gartner Peer Insights. *Gartner* [online] [accessed 2021-03-22]. Available at: https://www.gartner.com/market/field-service-management

JOBBER, 2021. Jobber: The #1 Service Scheduling Software & App in 2021 | Try for Free. *Jobber* [online] [accessed 2021-02-19]. Available at: https://getjobber.com/

KAMELIA, Lia, Eki Ahmad Dzaki HAMIDI, Wahvudin DARMALAKSANA and Afit NUGRAHA, 2018. Real-Time Online Attendance System Based on Fingerprint and GPS in the Smartphone. In: *2018 4th International Conference on Wireless and Telematics (ICWT)*. B.m.: IEEE, p. 1–4.

KOTEVSKI, Zoran, Natasa BLAZHESKA-TABAKOVSKA, Andrijana BOCEVSKA and Tome DIMOVSKI, 2018. On the Technologies and Systems for Student Attendance Tracking. *International Journal of Information Technology and Computer Science*. **10**(10), 44–52.

MAHESHWARI, Manas, 2021. *Democratizing application development inside Microsoft with the Power Platform* [online] [accessed 2021-03-21]. Available at: https://powerapps.microsoft.com/en-us/blog/democratizing-application-development-inside-microsoft-with-the-power-platform/

MICROSOFT, 2020. *Business Apps | Microsoft Power Apps* [online] [accessed 2021-02-10]. Available at: https://powerapps.microsoft.com/en-us/

MICROSOFT, 2021a. *Compare All Microsoft 365 Plans | Microsoft* [online] [accessed 2021-02-10]. Available at: https://www.microsoft.com/en-us/microsoft-365/business/compare-all-microsoft-365-business-products

MICROSOFT, 2021b. Get started with SharePoint. *Get started with SharePoint* [online] [accessed 2021-03-01]. Available at: https://support.microsoft.com/en-us/topic/get-started-with-sharepoint-909ec2f0-05c8-4e92-8ad3-3f8b0b6cf261?ui=en-us&rs=en-us&ad=us

MICROSOFT, 2021c. *OneNote, digital note taking app - Office* [online] [accessed 2021-01-20]. Available at: https://www.microsoft.com/en-us/microsoft-365/onenote/digital-note-taking-app

MICROSOFT, 2021d. *Pricing - Power Apps* [online] [accessed 2021-02-22]. Available at: https://powerapps.microsoft.com/en-us/pricing/

MICROSOFT, 2021e. *Task Management for Teams | Microsoft Planner* [online] [accessed 2021-01-20]. Available at: https://www.microsoft.com/en-us/microsoft-365/business/task-management-software

MICROSOFT AUTHORS, 2020a. *Microsoft Bookings* [online] [accessed 2021-02-22]. Available at: https://docs.microsoft.com/en-us/microsoft-365/bookings/bookings-overview

MICROSOFT AUTHORS, 2020b. *Overview of building a model-driven app with Power Apps - Power Apps* [online] [accessed 2021-02-10]. Available at: https://docs.microsoft.com/en-us/powerapps/maker/model-driven-apps/model-driven-app-overview

MICROSOFT AUTHORS, 2020c. *What are canvas apps? - Power Apps* [online] [accessed 2021-02-10]. Available at: https://docs.microsoft.com/en-us/powerapps/maker/canvas-apps/getting-started

MICROSOFT AUTHORS, 2021a. *SharePoint limits - Service Descriptions* [online] [accessed 2021-03-21]. Available at: https://docs.microsoft.com/en-us/office365/servicedescriptions/sharepoint-online-service-description/sharepoint-online-limits

MICROSOFT AUTHORS, 2021b. *What is Power Apps portals? - Power Apps* [online] [accessed 2021-02-22]. Available at: https://docs.microsoft.com/en-us/powerapps/maker/portals/overview

OO, Sai B., Nang H. M. OO, Suparat CHAINAN, Arpha THONGNIAM and Waralak CHONGDARAKUL, 2018. *Cloud-based web application with NFC for employee attendance management system* [online]. Available at: https://search-proquest-com.zdroje.vse.cz/docview/2055012655?accountid=17203

ORTH, Adrian, 2018. *Introducing model-driven apps – a new way to create* [online] [accessed 2021-02-10]. Available at: https://powerapps.microsoft.com/en-us/blog/introducing-model-driven-apps/

SOEWITO, Benfano, Ford Lumban GAOL, Echo SIMANJUNTAK and Fergyanto E GUNAWAN, 2016. Smart mobile attendance system using voice recognition and fingerprint on smartphone. In: *2016 International Seminar on Intelligent Technology and Its Applications (ISITIA)*. B.m.: IEEE, p. 175–180.

SULTANA, Shermin, Asma ENAYET and Ishrat Jahan MOURI, 2015. A smart location based time and attendance tracking system using android application. *International Journal of Computer Science, Engineering and Information Technology (IJCSEIT)*. **5**(1), 1–5.

UDDIN, Mohammad Salah, Shaikh ALLAYEAR, N. DAS and Fahad TALUKDER, 2014. A Location Based Time and Attendance System. *International Journal of Computer Theory and Engineering* [online]. 36–38. Available at: doi:10.7763/IJCTE.2014.V6.832

WANG, Yingli, Jean-Paul SKEETE and Gilbert OWUSU, 2021. Understanding the implications of artificial intelligence on field service operations: a case study of BT. *Production Planning & Control*. 1–17.

Annexes

Annex A: PowerShell deployment of a SharePoint list

```
#!!MANUAL!!
# 1) Create org-wide team
# 2) Set URL of the org-wide team SharePoint
$URL = 'https://xxx.sharepoint.com/sites/xxx
# 3) When browser opens, edit the “Contribute” permission level and add managers to the
"Managers" group
# 4) Deploy the Power App and change data source
# 5) Share Power App with everyone

#Automatic, no need to change or do anything
#Set path to list template
if ($psISE)
{
    $templatePath = Split-Path -Path $psISE.CurrentFile.FullPath
    $templatePath = $templatePath + '\magentaListTemplate.xml'
}
else
{
    $templatePath = $global:PSScriptRoot + '\magentaListTemplate.xml'
}

Connect-PnPOnline -Url $URL -UseWebLogin

#Create 'dochazka' list
Apply-PnPProvisioningTemplate -Path $templatePath

#Get the 'dochazka' list
$List = Get-PnPList "dochazka" -Includes ReadSecurity

#Set List Item-Security
$List.ReadSecurity = 2 #"Read items that were created by the user"
$List.WriteSecurity = 2 #Create items and edit items that were created by the user
$List.Update()
Invoke-PnPQuery

#Create the NEW permission level (clone the 'Contribute' default permissions)
$PermToClone = Get-PnPRoleDefinition -Identity "Contribute"
$addPnPRoleDefinitionSplat = @{
```

```
        Description = "Copy of Contribute + Override List Behaviors (view and edit all
list items)"
        RoleName    = "Managers"
        Clone       = $PermToClone
    }

Add-PnPRoleDefinition @addPnPRoleDefinitionSplat

#Read more: https://www.sharepointdiary.com/2019/05/sharepoint-online-set-item-level-
permission-in-list.html#ixzz6j9rLvfv6

$URLSettings1 = $URL + '/_layouts/15/editrole.aspx?role=Managers'
$URLSettings2 = $URL + '/_layouts/15/user.aspx'

#Manually edit permission level, add “Override List Behaviors” and assign users
Start $URLSettings2
Start $URLSettings1
```