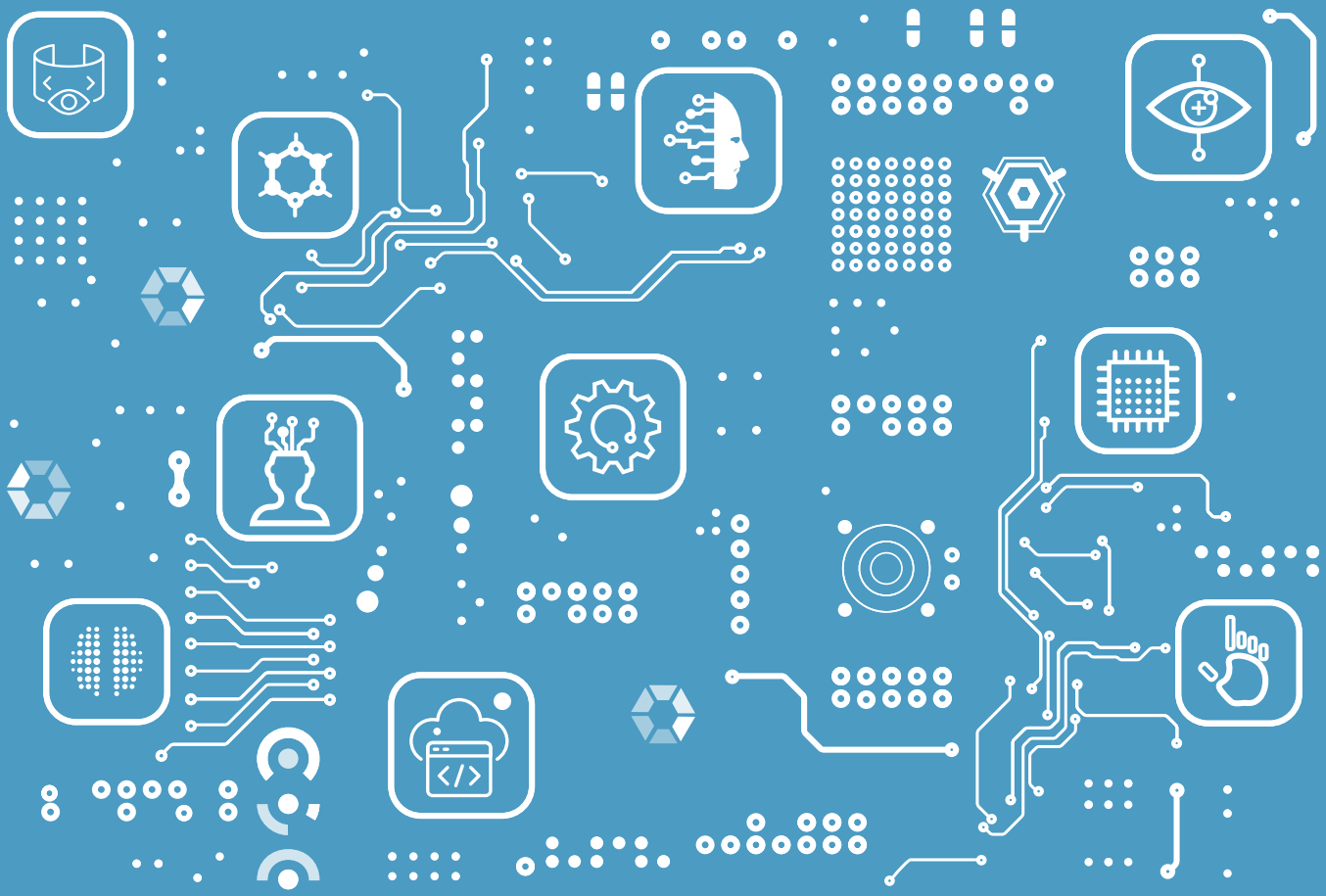
Qualium Systems

Methodology of VR/MR/AR and AI Project Estimation at Qualium Systems



Content

Intro

Estimation of IT projects based on VR, XR, MR, or AI requires both a deep technical understanding of advanced technologies and the ability to predict future market tendencies, potential risks, and opportunities.

In this document, we aim to thoroughly examine estimation methodologies that allow for the most accurate prediction of project results in such innovative fields as VR/MR/AR and AI by describing unique approaches and strategies developed by Qualium Systems.

We strive to cover existing estimation techniques used at our company and delve into the strategies and approaches that ensure high efficiency and accuracy of the estimation process. While focusing on different estimation types, we analyze the choice of methods and alternative approaches available. Due attention is paid to risk assessment being the key element of a successful IT project implementation, especially in such innovative fields as VR/MR/AR and AI.

Moreover, the last chapter covers the demo of a project of ours, the Chemistry education app. We will show how the given approaches practically affect the final project estimation.

1. Preparing for Estimation

1.1 Fundamental Stages for Accurate Project Estimation

When preparing for project estimation, we stick to several fundamental stages. These steps define the vector and tone of the entire workflow while ensuring the accuracy and objectivity of the estimation process with minimal time and resources spent.

1. Ensuring all elements necessary for the estimation are available

- **Deep understanding of the project:** A clear understanding of the project goal, its specifics, functionality requirements, and technical aspects is required to lay the foundation for the next estimation steps.

- **Selecting technologies and resources:** It is important to identify technologies to be used in the project and resources required for its implementation.

- **Considering additional factors:** Market conditions, team experience, infrastructure available, and other external factors may significantly affect the project and should be considered at this stage.

2. Focus on project timeframes

- Outlining realistic expectations of the project durations is essential to avoid misunderstandings with the client. A thorough analysis of all possible risks and unexpected circumstances provides for effective timeframe planning.

3. Specifics of preparing for innovative and experimental projects

- **Verifying and testing key concepts:** Especially for projects in the VR/MR/AR fields where it is required to prove the technical implementation of ideas.

- **Assessing hardware limitations:** It is important to consider the potential technical limitations of specific equipment, e.g., VR headsets.

- **Analyzing the market and competitors:** Exploring existing analogues and their testing helps identify unique project benefits and avoid known errors. It becomes possible to form competitive advantages and define the project's place on the market.

- **Creating demo versions:** Developing prototypes or demos based on project key functionality allows testing technical performance and clearly showing the new product concept to potential investors or customers.

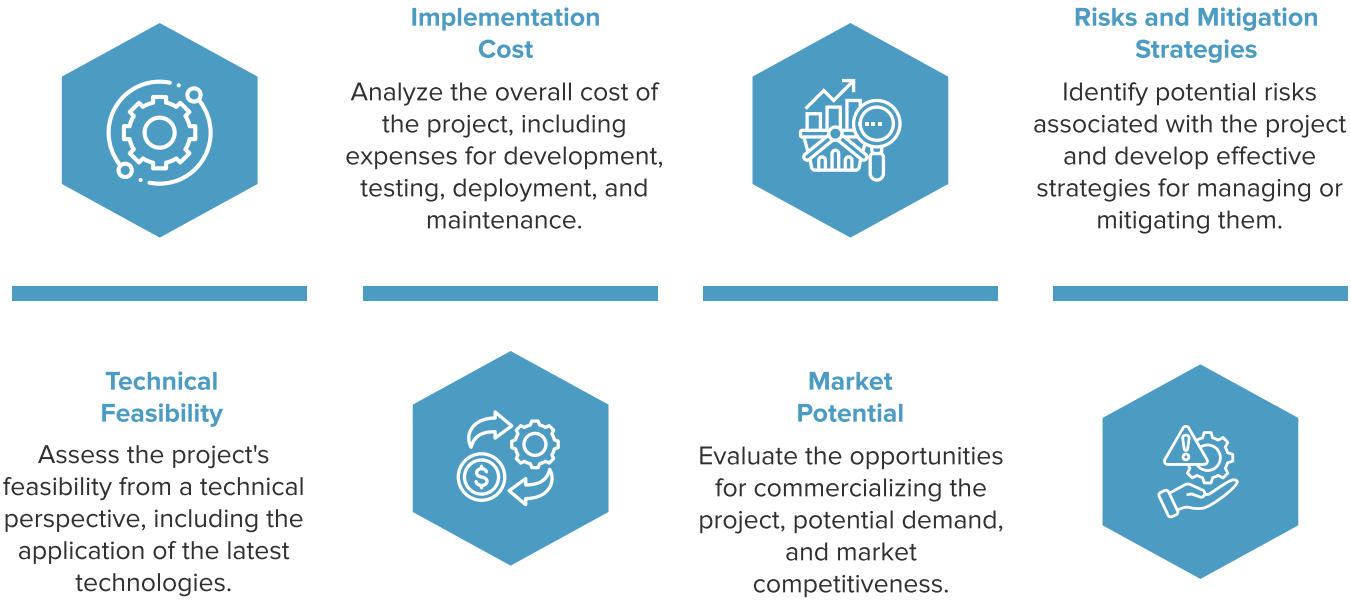
- **Collecting and analyzing information base:** Studying science articles, research, patents, and other information materials connected with the project ensures a complete understanding of the subject areas and helps to avoid potential issues at various development stages.

Each stage is an essential component in the process of preparing for IT project estimation and is aimed at minimizing risks associated with project implementation and ensuring its successful deployment. A detailed understanding of each aspect contributes to the formation of realistic expectations and effective management of the project at all stages.

1.2 Identifying Estimation Goals

At this stage, it is crucial to clearly outline estimation goals. It thus becomes possible to ensure a clear understanding of the tasks set for the team and the adaptation of estimation methodology to the exact project needs. Estimation goals must cover technical aspects, business requirements, the market potential of the project, possible risks and ways to minimize them.

In the process of setting the estimation goals, the following aspects must be considered: technical feasibility, implementation cost, market potential, risks and mitigation strategies.



Essential aspects for setting project estimation goals

Defining estimation goals also involves understanding the desired end results of the project and the performance indicators that will be used to measure its success. This may include developing specific metrics to measure performance, user satisfaction, time-to-market, and other key indicators.

1.3 Importance of Preparation Stage

The preparation stage plays a crucial role in ensuring the success of IT projects as it allows to:

- Ensure a thorough understanding of the project's goals, requirements, and specifics.
- Determine the most suitable methods and approaches for estimating the project.
- Minimize risks at early stages, providing greater predictability and control over the project.
- Prepare the foundation for developing a detailed project plan, including resource allocation, budget distribution, and work schedule.
- Promote increased involvement and responsibility of all project participants for its outcomes.

Thorough preparation and clear definition of estimation goals enable the team to navigate the complex process of developing and implementing IT projects effectively, especially those involving advanced technologies such as VR/MR/AR and artificial intelligence. This creates a solid foundation for successful project implementation, ensuring alignment with the set goals and customer expectations.

2. Project Types: from Demo to Full Product

2.1 Overview of project types

In IT and software development, there are several key types of projects, each with its unique goals, scope, and features. From demo versions to full-fledged products, understanding these differences is critically important for effective planning, estimation, and implementation of projects.

01	02	03	04
Demo The first step in validating a new idea is often the development of a demo version. This type of project aims to demonstrate key concepts and the potential of the product with minimal resource expenditure. Demos are ideal for attracting the attention of investors or customers to a new technology or product.	**Proof of Concept (POC)** POC is aimed at verifying the viability of a specific idea or technology. It confirms that the product can be practically developed by concentrating on technical aspects and potential issues that might arise during the implementation stage.	**Minimum Viable Product (MVP)** MVP includes developing a product with the minimum set of features necessary to attract real users and collect feedback. MVP is used for testing hypotheses about market demand without significant investment in a full product.	**Full Product** This type of project entails the development and market launch of a product with a complete set of features. Developing a full product requires a comprehensive approach, including planning, development, testing, marketing, and support.

Description of Product Development Stages

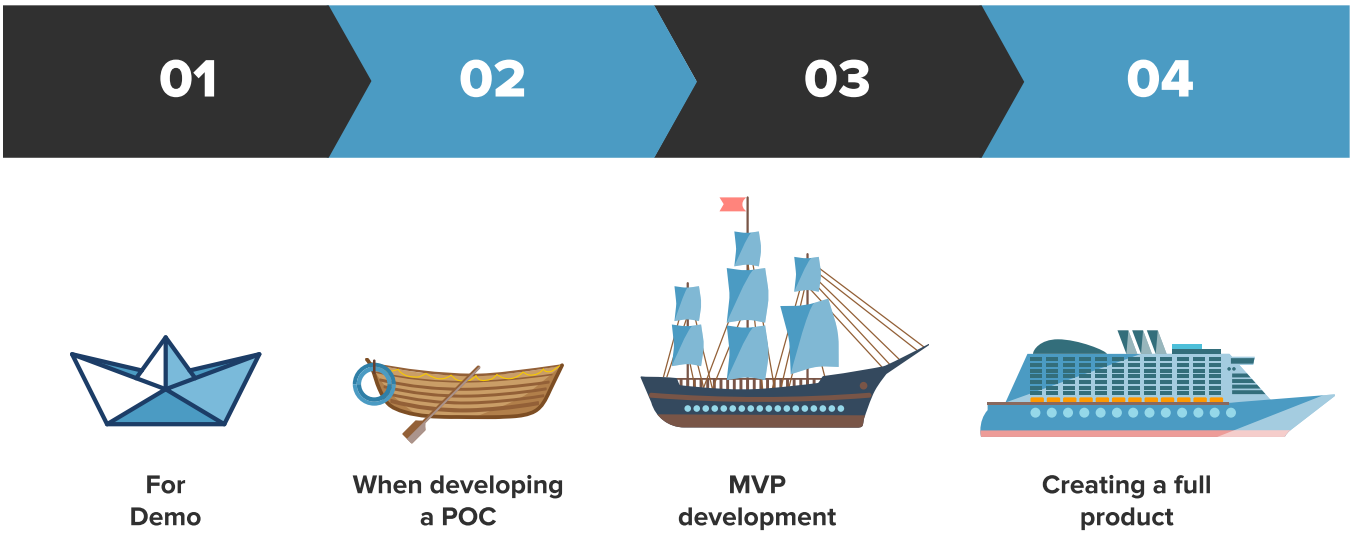
2.2 Planning and Implementation

For Demo projects, the key is the speed of development and high-quality presentation of the main ideas of the product. Such projects require a high level of involvement from designers and developers to create an impressive visual presentation.

When developing a POC, the main focus is on the technical implementation of the concept. The task is to demonstrate the viability of the idea, so the main efforts are aimed at solving technical problems and testing innovative solutions. This requires deep technical knowledge and a willingness to experiment.

MVP development aims at creating a product sufficient to attract the first users and get feedback. When working on an MVP, it is important to balance between the speed of bringing the product to market and its sufficient quality to meet the basic needs of users. The choice of technologies and development tools focuses on flexibility and the ability to quickly make changes based on feedback from real users.

Creating a full product requires an integrated approach and collaboration between different teams: developers, designers, project managers, testing specialists, and marketers. At the same time, it is necessary to ensure high product quality, safety, scalability, and readiness for long-term support. A full product development also includes planning marketing and sales strategies, as well as developing user support infrastructure.



Product Development Stages

2.3 Key Challenges and Strategies

Each project type offers unique challenges. For demo projects, one of the main tasks is to create an impression without unnecessary expenditure of time and resources. The strategy is to focus on key features and high-quality visual presentation.

When working on a POC, the main challenge is to demonstrate the technical feasibility of an idea. Here, the strategy focuses on minimizing development and using ready-made solutions and tools to quickly achieve results.

MVP requires finding the optimal balance between functionality, quality, and speed to market. The main strategy is to prioritize the core features that will meet the most important user needs and quickly gather feedback for further product improvement.

In the context of a full product, the challenges become even more complex, as it is necessary to ensure the full development cycle, including planning, design, development, testing, launch, and product support. The strategy involves comprehensive project planning and management, with an emphasis on quality and user experience, as well as creating an effective infrastructur for product support and updates.

3. Risk Assessment in IT Project Development

3.1 Risk Identification Methods

Risk assessment is a critically important stage in the planning and estimation of any IT project, especially when it comes to innovative technologies such as VR/MR/AR and artificial intelligence (AI). This process helps identify potential threats to the project and allows for planning strategies to minimize or avoid them.

Risk Identification Methods

Technical analysis

Studying the technical aspects of the project allows for the identification of potential technical risks, including technological limitations, complexity in component integration, or potential performance issues

Team expertise analysis

With the knowledge and experience of the development team it becomes possible to identify risks related to a lack of experience with certain technologies or project implementation methodologies

Market analysis

Market research and competitor analysis can reveal risks related to market demand, product competitiveness, as well as potential legal or regulatory constraints.

Customer requirements analysis

A deep understanding of the customer's goals and requirements helps identify risks associated with possible discrepancies between customer expectations and the project's actual capabilities.

Risk Assessment Stages in IT Project Estimation

3.2 Importance of Risk Analysis

Planning: Early identification of risks allows for project planning with potential obstacles taken into account, as well as optimizing the allocation of resources and time.

Customer Communication: Transparent discussion of potential risks with the customer fosters trust and understanding and provides for timely adjustments to project requirements or budget.

Flexibility and adaptability: Developing risk management strategies helps the project team be prepared for unexpected changes and respond to them effectively.

3.3 Risk Management

Preventive measures: Preventing risks by altering the project plan, technologies, or work methods. This may include additional testing, choosing more reliable technologies, or even changing the project scope.

Minimization: Mitigating the impact of risks if they materialize. This can involve developing contingency plans, allocating backup resources, or preparing specific crisis response measures.

Risk transfer: Sometimes management of certain risks can be transferred to third parties, for example, through insurance or outsourcing complex or risky parts of the project to specialized companies.

Acceptance: In some cases, especially when risks have a low probability of occurrence or impact, the best option may be to accept these risks as an integral part of the project with planned corresponding response measures.

Assessing and managing risks is an essential part of IT project management. Implementing an effective system for identifying, analyzing, and responding to risks allows for minimizing potential threats to the project's success and ensuring a high level of implementation.

4. VR Chemistry Lessons App Estimation

4.1 Project Description

General project description provided by the customer (non-detailed technical task, minimum necessary for estimation): the customer wants to transfer student learning to a virtual environment with a visual design as close as possible to a regular classroom. At this stage, they need a Demo project for investors to demonstrate the possibility of studying the school chemistry curriculum in a virtual environment with visualization of the combination of chemical elements into compounds.

Number of formulae in the demo: 10. Provided by the customer.

Order in which formulas appear: arbitrary.

Target VR gadget: Oculus Quest 2 and 3, with no need to connect to a PC.

Rendering Pipeline: URP.

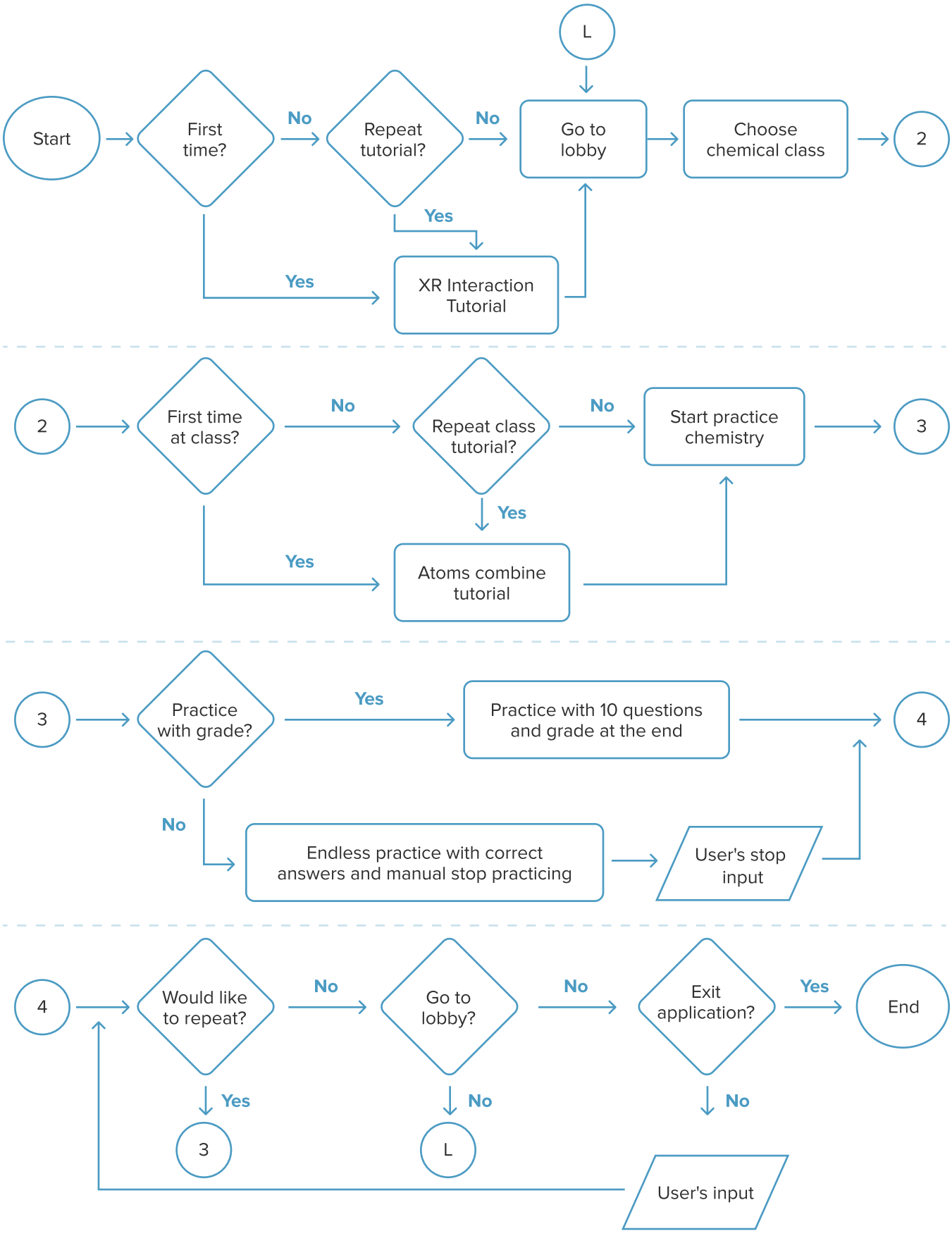
Platform: Android.

Target date: as soon as possible.

4.2 User Experience Design

The user appears in a school corridor, where a quick tutorial on internal interactivity takes place (introductory training for novice users), after which they are transferred to the chemistry classroom. The user must complete tasks that appear on the school board by selecting elements from the periodic table of chemical elements, which is also present in the classroom.

Each element (atom) should be appropriately labelled, have a spherical shape, and possess the corresponding number of covalent bonds for combining with other atoms. The resulting compound molecules should also be interactive and able to be disassembled back into atoms.



User Flow for Chemistry Classroom Experience

Exterior Design:

The location must have a corridor with doors leading to various classes with different curricula/processes. It was discussed with the customer that class models must be chosen by the developer as the customer is not familiar with the requirements for real-time rendering engine models and is unaware of how to check models for the number of polygons, geometry errors, or pre-optimized textures for working in Unity for URP.

Exterior Design Sketch

Interactivity:

All internal interactions must be performed only with hands and gestures, which leads to the need for hand position recognition in space and hand gesture recognition. Controllers are not used in this case.

Moving around the scene:

Movement within the scene should be implemented through a teleportation system triggered by a specific hand gesture.

4.3 Project Estimation

Tools:

According to the customer requirements for the target device, the application will be developed using Unity Engine, Meta XR All-in-One SDK, and as many "out-of-the-box" solutions as possible regarding interactivity.

Development:

Being a demo project, it needs to be developed with minimal resource involvement and without unnecessary functionality — only those features that can demonstrate the main idea of the application. It is required to have minimal possible user interaction with the virtual environment to shorten the scope of work for developers and QA specialists.

The development is broken into separate stages, each resulting in a certain functionality/module that is independent of the specific implementation of other modules and can be tested by QA separately. This allows the client to scale this implementation if a decision is made to continue developing the product or even remove it or replace it with another one if necessary.

This approach enables the application of Agile/SCRUM methodology for development planning and parallel module development.

Comments on the estimation process:

1. **Non-obvious time:** project estimation should include the time for setting up the working environment for its development. This is a useful tool for the client to check which tasks and milestones the project is broken into, which tasks have already been completed, where the repository with the project is located, and much more. Similarly, time needs to be allocated for creating intermediate builds by developers and polishing the application according to feedback from the client and QA.
2. **Importing models into the project:** any imported model needs to be configured for the project's needs. None of the imported models will even have colliders (a Unity element that prevents objects from passing through each other). Depending on the model format (.FBX, .dae, .3DS, .dxf, or .obj), there are specific import settings, and all of this takes time. The most time-consuming part is the mutual placement of these models as objects in the scene.

4. **SDK integration:** even standard functionality from the SDK always requires integration and configuration according to the project's needs. Each such solution must work together with other integrated solutions. And the more there are, the more time it takes to configure.
5. **Development:** every developer sooner or later encounters a sense of Déjà vu — they have already developed what they need to develop today. This is one of the reasons for the existence of design patterns — typical solutions to problems that are frequently encountered during software development. Unlike ready-made functions or libraries, a pattern cannot simply be taken and copied. A pattern is not a specific code; it is a general concept for solving a particular problem, which needs to be adapted to the needs of a specific project. Therefore, an experienced developer always has a general understanding of how long it usually takes to write functionality, how quickly they can integrate it based on the project architecture, and what potential problems might arise during development.

Optimistic scenario: 332 hours

Most likely scenario: 391 hours

Pessimistic scenario: 448 hours

Formula for estimating project duration:

$$\textbf{Estimated time} = \frac{(\text{Optimistic} + 4\text{xMost likely} + \text{Pessimistic})}{6}$$

Time for budgeting = 391 hours

The project size and the chosen development plan require the involvement of two Unity developers: 1 Middle-level developer and 1 Junior-level developer, who will work alongside 1 PM for coordination and 1 QA for timely identification of areas needing improvement.

Thus, the approximate calendar time required to develop an application should be calculated based on the number of developers in the team.

Calendar time required for development in weeks:

$$\textbf{Calendar time} = \frac{\text{Estimated time}}{\text{Working hours per week} \quad \text{Number of developers}}$$

Calendar time: 5 weeks

In the end, the customer gets a git-repository copy with the finished project, APK release, and documentation describing the project modules.

VR Chemistry Demo, Estimations

Development Estimate

Overview

Platforms	Android
Technologies	Unity, Meta XR All-in-One Unity SDK
Duration	4 - 6 weeks
Dedicated Team	2 x Unity Developers, 1 x Project Manager, 1 x Quality Assurance Specialist

Work Breakdown Structure

Phase	Work Item	Description	Estimation (min), Hours	Estimation (mid), Hours	Estimation (max), Hours
Project Setup	Setup: Working Environment	Create git project, create Unity project with latest LTS version, create and setup Jira and link it with git	4	5	6
Scene Assembly	Choise of the School Models	Choose the models of school at the Unity Store or alternative model stores and agree them with the client.	16	18	20
	School Model Import	Import models to the project, set them up and assemble the scene envoirnment.	40	45	50
	Meta XR Integration	Intergrate the Meta XR SDK and set it in the project.	6	7	8
	Gesture Recognition	Integrate and set the geture recognition and prepare the basic gesture for further work.	8	9	10
	Raycast Interaction System	Intergare the Raycast Interacton System into project and set it up for further work. The ray should be casted from each index finger when the hand has the Index Gesture.	3	5	6
User Input	Interaction Gestures	Create the interaction Gestures and link them to required functionality.	4	6	8
	Teleport System	Create the teleport system to move around the scene when the hand has the Teleport Gesture.	4	6	8
Chemical Elements	Periodic Table	Creating the prefab of the Periodic System to be possible to get the exact raycasted chimical element.	20	24	26
	Elements (Atoms)	Create the basic prefab of chemical element with readable text mark and covalent bond set could be adjust in the inspector. Create the pool of elements according to pereodic table.	40	50	60
	Molecule Creature Features	Create the feature to link the elements if they have the free quantity of required covalent bonds.	24	28	30
	Interaction with Elements and Molecules	Create interactions to be possible to grab single element by the ray, get it closer to the hand and be able to link it with any another element. The same functionality should have the molecule (already linked elements).	16	18	20
	Molecular Disassembly	Create the feature that when the molecule is hold by one hand and anotehr hand holds and pulls out one of molecule's element — this element becomes separated.	12	14	16
User Tutorial	UI Elements	Create the UI System to show the step-by-step tutorial.	6	7	8
	Tutorial Videos	Create the video with ready feature of actions that user can do within his journey. Optimize the videos and add the Video Player to the Tutorial UI.	4	5	6
	Tutorial System	Create the tutorial system to check if the required action is done before move to the next step.	12	14	16
Demo Learning	Task Generator	Create the Generator of tasks that will be shown at the blackboard. Total 10 formulas to assemble. The order of shown is random.	4	5	6
	Result Checker	Create the checker of result: it should check the correctness of the elements binding, if the no free bonds. It shold be possible to render on demand the formula of element assembled of the user in proper way.	24	26	30
	Grading System	Create the symple gradle system with pre-defined quintity of possible mistakes.	4	5	6
Polishing	APK Building	Time reserved for apk building for internal tests and provide them to client for further testings.	2	3	4
	Project Polishing	Time reserved to fix the bugs and make the amendments in accordance to QA and client's feedback.	12	13	14
QA Testing			40	47	54
Project Management			27	31	36
Total			**332**	**391**	**448**

Final estimation of VR Chemistry Lessons App

4.4 Risk Management

At this stage, no other SDK will be engaged in the project. Thus, the risk of problems with the mutual integration of different SDKs is minimal.

Main risks that can affect the development timeframes:

1. Model agreement: optimized models selected by the developer for the project may not go down well with the client (risk of "preferences"), and therefore some of the agreed models will need to be changed or optimized by involving 3D artists in the project.
2. Interaction with elements — setting up the smoothest possible connection (and disconnection) of elements may take more time than the development of such an interaction itself.
3. Writing the correct formula for the user-created molecule and its comparison with the task formula may require additional research in the field of theoretical chemistry.
4. Unplanned changes the client may want to make during the project development and which may affect already implemented modules. Each change will require additional estimation and approval from the client.

4.5 Transition from Demo to MVP

It may seem like the demo already has everything necessary. But that's not entirely true. The demo lacks flexibility — it is executed in the spirit of a rail shooter, where the user performs only the actions allowed by the developer. Most importantly, the application does not implement the learning process: there is no teacher or other students, nor are there any educational materials. Not to mention that it has only one classroom.

Therefore, the MVP requires:

- Connecting multiplayer with multi-session support.
- Different user roles with different functionalities: teacher and student.
- Setting up a UI panel for the teacher to manage the learning process.
- Setting up an admin panel (web page) with the ability to upload educational materials such as videos, graphics, and books to the class without the need to rebuild and reinstall the application.

- Setting up voice communication with prioritization of the teacher's voice channel.

The listed items alone require at least 1000–1500 hours of development. But true chemistry education needs what we love chemistry for — chemical experiments! And each of them needs to be estimated separately :-)

Summary

In this White Paper, we've covered the key aspects of IT project estimation with a focus on such fields as Virtual, Augmented, and Mixed Reality, including AI projects. We've thoroughly analyzed the estimation methodologies that enable the most accurate prediction of project results while highlighting unique approaches and strategies developed by Qualium Systems.

The estimation process of IT projects involving advanced technologies is a complex and versatile task. From a deep understanding of the project and its specification to market analysis and the formation of effective management strategies, each stage requires a mindful approach and high qualifications.

However, the use of a complex approach to estimation which includes a clear definition of project goals, in-depth market and technology analysis, as well as systematic identification and management of risks, allows for minimizing potential threats and ensuring high quality and success of the project.

Considering the speed of technological progress and fluctuations in market conditions, it is important not only to use verified methods but also to be open to new ideas and approaches. This will enable effective implementation of current projects and help to adapt to future challenges that will undoubtedly arise on the path to innovation.

At Qualium Systems, we believe that shared knowledge and experience are key to the successful implementation of complex IT projects. We hope this doc will serve as a valuable resource for everyone engaged in the estimation and development of IT projects and inspire new achievements in this exciting field.

Chat to us

Our friendly team is here to help.

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