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Development of a Strategy Roadmap for the Widespread Implementation of Extended Reality

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Abstract: Digital transformation has led to a multitude of new technical solutions. This includes Extended Reality technologies: Hardware and software systems that enrich the real environment with information. The area of application extends to the entire value chain and thus offers great potential for companies. A systematic and holistic implementation strategy is necessary to exploit this optimally. XR solutions often remain prototypes mainly because of lack of knowledge management and missing understanding about the technology. In this respect, this article presents a tool for the systematic, holistic strategic consideration of XR from the vision to the planning of measures. The tool presented combines common methods such as the Strategy Map, the Transformation Map or the Balanced Scorecard. Thus, it does not only offer companies a strategic framework, but also includes concrete measures for a sustainable, successful implementation.

Keywords: Change Management; Extended Reality (XR); implementation; strategy; management

1 INTRODUCTION

The ongoing digital transformation is no longer a trend. In 2023 it describes the technological status quo. This forces companies to act and deal with new possibilities. A systematic approach is recommended to be successful in the long run. [1] It is important to define a path at the strategic level, to be able to shape it operationally.

Classical management theory agrees on that and emphasizes the value of high-quality strategic work. However, corporate success is not secured by the formulation of a general digitization strategy. It has to be split into sub-strategies according to specific operational areas. This also applies to the implementation of far-reaching technologies, as is the case for the introduction of new technical or digital (work) assistance technologies.

In this respect, the group of extended reality (XR) technologies including augmented, mixed and virtual reality is an important technology area in industry. [2] This research is underlined by current tech trend barometers. [3, 4] This has been further reinforced by the COVID-19 pandemic. [5] XR technology uses digital devices to enrich the real world with digital information. [6] A technology strand as a new work tool can often intervene in existing processes across the entire company and improve them. Fields of application and areas of use are complex and range from human resources to research and development, sales, and production. [7]

Potential applications also lead to a wide range of technical solutions regarding both hardware and software. This is breadth of possibilities must be systematized to achieve the optimal result for each company. The necessity of strategic consideration of XR integrations thus becomes clear. Nevertheless, companies currently still place little focus on this strategic consideration. Often, XR solutions are purchased for prototypical use cases and do not go beyond this status. Systematic and strategic embedding and active support of these applications can help to prevent these situations.

The paper takes up this initial situation and presents a strategy tool to enable a sustainable, successful and holistic implementation of XR technologies in companies. The tool also includes the planning of measures and translates theoretical strategy into practical procedures. This interweaving of content and system represents value added in this field of research. The strategy tool was developed due to multi validated conceptional research by the authors translating different strategic approaches to the implementation of XR solutions in industry. In detail, the common methods Strategy Map, Transformation Map as well as Balanced Scorecard were combined and supplemented by the requirements of the industry. As for the contents, those aspects of the methods were used which were considered to be specifically relevant for the implementation of XR.

This research is part of a collective research project. It is nationally funded by the Austrian Research Foundation FFG. The practical validation was done with 20 partner companies in the project.

2 CHANGING TO EXTENDED REALITY

XR is one of the most relevant emerging technologies to come out of the fourth industrial revolution. [1-3] The focus is to enrich reality with information in different ways. Depending on the technology, data from different systems can be linked and displayed via a digital device in a location- and time-flexible manner. It is also possible to superimpose virtual information on reality in real time to enable remote support or remote training. Moreover, the technology enables working on and with virtual objects, such as a digitally modeled plant, a machine or individual components, which in turn opens up a wide range of possible applications. [6]

The use cases described show that XR is not a new, detached technology that performs individual steps of work in a similar way to a machine. Rather it is a work tool that changes the way activities such as assembly, training, maintenance or product development are carried out. [2] But not only previously mentioned processes are affected. By making information widely available, XR makes it possible to bring decision-relevant information to all areas of the company - from management to shopfloor. This enables decentralization of decisions and associated enrichment and enhancement of workplaces. [8] However, this also implies a

change in the behavior of employees [7], towards "Augmented Operators" [9], making employees' key elements of the implementation of XR. A high level of acceptance of the technology is necessary in order to achieve a sustainable and successful introduction. [10, 11]

Due to the multitude of potentials of XR for companies and the need for change that results from the use of XR for work processes, the broad implementation of XR is to be classified as a comprehensive change that should be accompanied by systematic change management.

In terms of change management, the clear formulation of a goal as well as the related design of the goal achievement represents a central element in order to achieve acceptance and cost efficiency during the implementation. [12] 70% of all change processes fail due to the lack of a clear goal and a systematic approach to change. [13, 14] Therefore good strategic planning, support and monitoring are essential for the success of the implementation. This clearly shows the need for strategic considerations during the rollout. [1]

3 KEY FACTOR STRATEGY

Without a well-defined plan, companies may struggle to integrate the technology effectively, leading to wasted resources and lost opportunities. A clear strategy should outline the goals and objectives of the XR implementation, identify the specific use cases of the technology, and specify technical requirements and infrastructure needed to support it. [1]

The implementation of a XR technology in companies usually takes the following path: a person who is interested in the topic starts testing the technology. Sometimes several projects run in parallel in different departments, which leads to ambitious but un-coordinated initiatives. [15] This hands-on approach makes sense for testing the possibilities of a technology. However, it also harbours the risk of technological "island solutions", if they emerge they do not result in a sustainable strategic implementation in the company.

A new technology opens up many opportunities for companies. However, to be able to put these opportunities into practice, it is necessary to rethink and transform the organizations themselves, their established processes and corporate culture. Therefore a successful long-term implementation of XR solutions corresponds with profound changes in companies and poses a multitude of challenges [16, 17].

Strategy also plays a crucial role in managing the risks associated with a new technological implementation. Although XR technology itself is not expensive, the implementation may involve time-consuming investigations and programming. It is not a technology that is built up in a short time and therefore needs long-term commitments. Therefore, a strategic approach is necessary to ensure the long-term viability of the technology. [1]

Based on this information the authors decided to use established strategy tools as the 'Balanced Scorecard', the 'Strategy Map' and the 'Transformation Map' to create a tool chain to establish XR in a company sustainably. These tools are already known in the companies surveyed.

The **Balanced Scorecard** (BSC) is a strategic management tool that helps organizations to translate their vision and strategy into action. The BSC provides a framework to align organizational goals with performance measures and targets. This helps organizations to focus on the most critical drivers of success. The BSC includes four perspectives: financial, customer, internal business processes, and learning and growth. Each perspective includes specific objectives, measures, targets, and initiatives that help organizations track and manage their progress. [18]

The **Strategy Map** is a tool to visualize and communicate the strategic objectives of an organization and how they are linked to each other. The strategy map provides a clear and concise way to communicate complex strategies to stakeholders, including employees, investors, and customers. The strategy map includes a visual representation of the organization's goals, objectives, and measures, as well as the relationship between them [19, 20]. The strategy map is a valuable tool for the implementation of a technology as it helps organizations to communicate the value proposition of the new technology. [21]

The **Transformation Map** is a visual strategic mapping tool, similar to the 'Business Model Canvas'. It is used for all scales of initiatives and activity to map outputs to outcomes, outcomes to objectives and objectives to an overarching vision. In a transformation map, all actions required to reach the key objective within a context of change are listed. The transformation map provides a clear and concise way to visualize and manage the relationships between different systems and stakeholders involved in the implementation of a technology. [22]

4 METHODOLOGY

The main research goal was to develop a tool to not only develop a XR strategy, but also to guide a company through the entire implementation process. Therefore, it was necessary to combine established methods and adapt them to the circumstances and needs of companies to increase the possibility of usage in practice.

This objective results in a multi-stage research design:

1) Scientific substantiation
2) Surveying industrial practice
3) Development of a holistic strategy tool
4) Practical validation
5) Adaptation and finalization of the tool

Two areas of research were examined to provide a **scientific basis (1)** for the study. First, established models for deriving corporate strategies were reviewed. In this respect, it was essential that the models did not focus on individual aspects but take a holistic view of the company. Because of the research, the 'Transformation Map' and the 'Strategy Map' were considered particularly suitable. In combination, these provide the rough framework for the new tool. The more detailed elements were derived based on the 'Balanced

Scorecard'. It takes into account both hard facts and soft facts, which was considered essential for the introduction of XR.

The literature research was supplemented by a **survey of practitioners (2)**. To this end, a workshop was held by the partner companies involved in the project. The goal was to determine which tools are already established in the companies for strategy development and strategic planning and why. In combination with the results of the literature research, the **tool for strategy** development and support presented in this paper was **developed (3)**.

The prototype was subjected to **practical validation (4)** for quality assurance purposes. Three independent companies from different industries took part. They tested both the content of the tool and the implementation process for practicability, user-friendliness and understanding. The findings generated in this way were incorporated into the **final development of the strategy tool (5)** and contributed to quality improvement, particularly with regard to the practical usability of the tool.

The following chapter shows the design of the tool in detail.

5 RESULTS

5.1 Developed Strategy Tool

The strategy tool as shown in Fig. 1 is based on a structured approach under the assumption that strategies are developed focusing on the entrepreneurial vision, mission and targets. With the help of this tool and the methodology stored within, the target state can be efficiently defined and the way to achieve it can be designed.

Based on the BSC model, perspectives were formulated. Based on these perspectives the implementation path was concretized. The following perspectives serve as sub-areas for this purpose:

1) Finance
2) External stakeholders (customers, suppliers...)
3) Internal stakeholders (key users)
4) Processes.

The classic strategy process, based on a strategic analysis of the initial situation, is based on data and insights of the past and/or current time. In today's world, in which companies have to deal with high volatility, uncertainty, complexity and ambiguity (VUCA) [23], this approach falls short. Consequently, the time horizon, which is supposed to represent the path from the initial situation to vision, is divided into periods. The color attenuation shows the decreasing level of detail of the planning over time.

In addition, the focus was placed on economic but above all ecological aspects, which must be taken into account. In this case XR applications play a fundamental role. This ecological view is placed above all perspectives in each period.

The tool developed by the systematic approach described is a VBA (visual basic application) Excel tool, which, as a systematic strategy process is divided into several phases. An Excel tool was chosen because all partner companies are familiar with Excel in a corporate context. Both user confidence and the high degree of familiarity have a positive effect on the use of the tool.

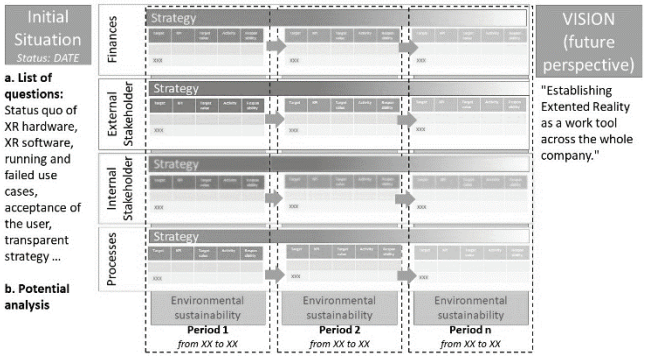

Figure 1 Strategy tool framework

Methodologically, the tool consists of eight spreadsheets, five content related (written in Italic) and three supporting ones:

1) Introduction to the topic
2) Fill-in help and FAQ
3) *Initial situation*
4) *Vision*
5) *Sub-strategies*
6) Example of goals and dependencies
7) *Template Goals*
8) *Template dependencies*.

It starts with an **introduction (1)** to the topic to explain the general approach of the tool, the benefit of it and what it should be used for. The **Fill-in help (2)** explains which steps should be taken to work with the tool efficiently. Also, a **FAQ (2)** section was created mainly based on the information from the practical validation as described in chapter 5.2.

After that, the core of the tool starts. The first step in developing a strategy for the introduction of XR in the company is to discuss the **initial situation (3)**, with the help of the knowledge gained from an analysis of the current situation. As already mentioned, this takes place in the four perspectives finance, external stakeholders (customers, suppliers...), internal stakeholders (key users) and processes. Questions in the tool lead the editors to the answers being the basis for a holistic vision for the implementation of XR. Topics are about the actual status quo of XR including previous experiences with XR and existing competences. Furthermore, a potential analysis is suggested in this phase in order to find areas of application for XR within the company. This can be done either by means of expert interviews or by an on-site analysis in the company. As a result, the initial situation is described with the help of the knowledge gained from the as-is analysis.

Subsequently, a **vision (4)** for the introduction and definition of the desired benefits of XR applications in the company is created. This is done with three relevant questions:

1) What do you want to achieve with XR in your company?

2) Why do you want to implement XR in your company?
3) What role do you want XR to play in your company in the future?

The vision is a motivating, positively-formulated presentation of the goals to be achieved through the use of XR technologies. To this end, this vision sets a direction in which companies want to move and where they want to be in the future; using XR-technology.

Using the information now available, **sub-strategies (5)** are derived from the perspectives: Finance, External Stakeholders, Internal Stakeholders and Processes. This makes the overarching strategy more concrete and therefore tangible for the individual areas of action. In this case, it is essential that sub-strategies be clearly in line with the vision. These guidelines provide the framework for concrete action planning.

At this point, users are shown based on an **example (6)** how the planning of targets and actions should be carried out and how individual measures can be considered in terms of time and content. This is necessary to avoid delays in the implementation of the individual measures.

Based on the sub-strategies defined in advance, **goals (7)** are derived with associated key figures, measures and their statuses in the next step of the target definition, as shown in Fig. 2.

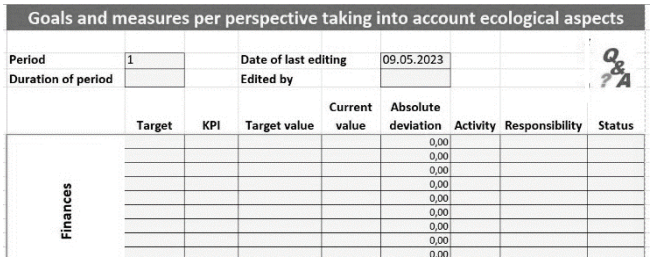

Figure 2 Detailed planning of goals, measures and responsibilities

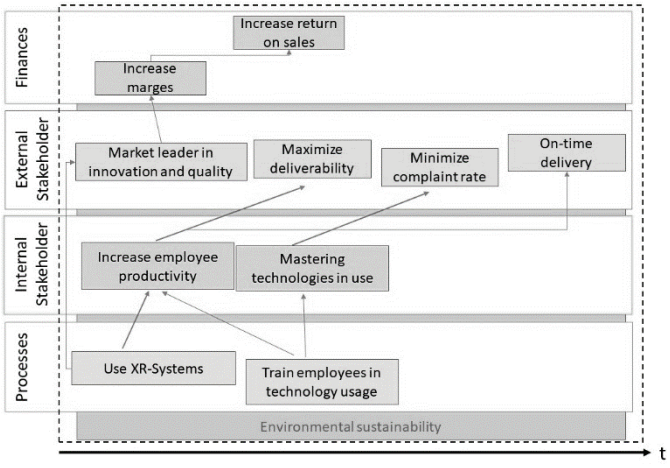

Figure 3 Example for the planning of dependencies

In order to make specified goals measurable and traceable, a key figure (KPI) is assigned to each defined goal. Subsequently, measures are defined to achieve these goals efficiently and effectively. These also serve to develop recommendations for action. In addition, responsibilities are defined for each target value.

In the last spreadsheet of the strategy tool, the individual goals, which have been assigned a target value, as well as some additional strategically particularly relevant goals are **set in relation (8)** to each other. They must be planned dependent on time and content (8) as shown in Fig. 3. This is to avoid bottlenecks and delays in the achievement of measures.

The filling of the tool can be done with the support of consultants as well as by the company itself. Therefore, general information and a fill-in guide were placed within the tool that are found in the first two spreadsheets of the excel file.

5.2 Validation of the Tool

As described within the methodological framework in chapter 4, the tool has been practically validated with three companies in 2022. The companies were asked to give feedback on the following areas: Comprehensibility, usability, ease of use and practicability in application. In the first step of the validation, the companies familiarized themselves with the tool and submitted written feedback to the authors. This was important, since the aim was to develop a self-assessment tool. The second step was made up of personal feedback-meetings that took place with each validation partner to discuss the adaptions we proposed based on the feedback.

The employees involved in the validation were responsible for the implementation of XR solutions in the respective companies and already had experience in both XR and strategic planning.

Since the project will run until the end of 2023, the focus in this publication is on the description of the tool and not on current data from a project partner. A publication of a real example of a project partner will take place in a separate publication at the end of 2023.

However, the first feedback from the project partners was recorded to further improve the quality of the tool. The following table 1 shows the main feedback of the partners.

Table 1 overview of the main validation feedback

Validation partner	Feedback
Company 1 (metal industry)	• Add advice, who should fill in the tool • Change vision to reflection • Add current value • Define level of detail to fill in the tool
Company 2 (technical services)	• Introduction to the topic clear • Add navigation button to Q&A in every sheet • Add button to duplicate periods automatically • Add responsibilities to BSC attributes • Add a practical example
Company 3 (transportation)	• Explain terms such as internal or external stakeholder • Questions are clear • Different parts of the tool require different people working with the tool

The feedback mainly targeted the usability and ease of understanding of the tool itself. The choice and combination of strategic tools was mentioned positively. The Authors evaluated the results of validation and came up with some adaptions/supplements of the tool. Most of the comments led to questions now answered in the aforementioned FAQ section of the tool.

The first prototype contained only the recommendation on how to proceed, but not an exemplary presentation and the description of individual terms.

To guide companies, a suggestion was made on which functions in the company are useful for the development of the individual steps. For example, for step 1: "Analyze the initial situation" it is recommended that a change manager in conjunction should do this with decision-makers and employees of the target departments.

The FAQ now includes an explanation of the most important terms, such as the term "stakeholder". This is essential to achieve a uniformal understanding of the terminology used to work with the tool.

To increase the usability of the tool, a direct link to the FAQ spreadsheet is provided on each sheet of the strategy tool.

6 RECOMMENDATIONS

The literature emphasizes several times the importance of strategic planning in different business areas. Strategy provides the guidelines and defines the company's activities. It is therefore even more important to include company-wide changes in the overall corporate strategy and to accompany the respective change strategically. This also applies to the introduction of XR in the company.

Furthermore, the development of the tool presented in close cooperation with companies has shown that a strategy tool should ideally be directly linked to implementation planning and success control. This proximity in terms of content not only shows the direct link between strategy and operational activities, but also illustrates the importance of the planned change.

With regard to XR applications in particular, it has been shown that in practice there is often still no dedicated XR strategy. However, in view of the amount of potential and the far-reaching effects of the technology on work processes, strategic consideration and planning is recommended.

In addition to the positive feedback of the companies, the practical validation also resulted in limitations. For example, the tool is only fully useful if it is directly coupled with other existing strategic tools. This means that it is no longer seen as a separate stand-alone solution within the company but is integrated into existing processes and strategic considerations. Furthermore, it was found that although the companies rated the usefulness of the tool as high, its use often fails due to a lack of routine. Therefore, the authors developed their own training workshop for the tool and held seasons several times. This increased user motivation.

Overall, it can be stated that the tool presented helps to approach the introduction of XR as a work tool in a company in a holistic manner. However, if the company decides that before the implementation the respective XR use case should be an isolated solution, the tool is too extensive and not recommended.

The tool has already been used to provide support that is more intensive to several companies in their XR strategy development. The results of this are not yet finalized, but will be part of a follow-up publication.

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