

MBAB 821 TECHNOLOGY MANAGEMENT

SEMESTER GROUP POE

Brainpower Troopers 2:

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INTRODUCTION

The North West University caters for over 45 000 students across its three campuses in Vanderbijlpark, Potchefstroom and Mafikeng. The university implemented a strategy 2015-2023, as part of its strategic focus Digitization, Innovation and Technology have been perpetuated and propelled by the effects of Covid-19. The NWU has been offering physical classes and distance learning for several years; Covid-19 has helped develop online education, and a hybrid learning system has been envisaged for the near future.

Online education creates a brilliant platform with access to information and knowledge readily available and reaching the far corners of the globe. Within this lies an opportunity to increase the NWU capacity, stretching its reach and capability to serve better, not only nationally but globally. With it comes challenges of disassociation to fundamental elements and experiences that may be experienced in class, some students still prefer physical contact and materials.

Virtual reality provides secure and individualised solutions using Augmented Reality to replicate many of the senses and experiences that one would experience in a real classroom environment. It offers numerous advantages such as Virtual Interaction, Events, E-Commerce & Advertising, Distance Learning, Multi lingual solutions, Game/Example based learning & Experimentation, Virtual Administration, Registration & Campus Tours as critical student experiences and uses within a University setting. This multimodal learning solution and tool offers departments and and the University multiple solutions.

This project will focus on the development of an Innovation Department within the NWU setting, tasked to develop distance and online learning platforms through the use of Virtual Reality Technology and linking it to multi-disciplines and uses within Student-life.



PART 1

Thinking of a Technological Innovation: Virtual Reality in Education

DEFINING THE DEPARTMENT & INDUSTRY



The first VR headset was patented in the 1960's and was named the 'Telesphere Mask' by inventor Morton Heilig (Institute of Imagination, 2015 – 2020).



No single person invented virtual reality, it has been a collaboration and continuous effort by a multitude of persons and industries to bring it to where it is today (Soriano , 2016).



There are three main types of virtual reality used today to transform the world around us, including non-immersive, semi-immersive, and fully-immersive simulations (Poetker, 2019).



The global augmented and virtual reality in education market size to grow from USD 9.3 billion in 2018 to USD 19.6 billion by 2023, at a Compound Annual Growth Rate (CAGR) of 16.2% during the forecast period (Market and Markets, 2019)



About 75% of the Forbes World's Most Valuable Brands have created some form of virtual reality or augmented reality experience (Soriano , 2016).

The department will be responsible for transforming and developing platforms for integrating AR/VR into lesson plans and course curriculum, ensuring that all content and experiences are integrated into a virtual and easily accessible experience. The four focus areas for the department are based on the NWU's vision and requirements to meet the futures digital needs, namely:

- E-learning: the department will invest in VR technologies for its communicative and integrated learner experience capabilities. Students have reported that there is a disjoint and many distractions that prevents a conducive environment for learners. Through VR technologies one is able to create an immersive environment that captures focus, attention and mimics or replicates a real learning experience as if it were the same thing. Learning is a continuous process and due to the influence of technology and access to technology we need to feed these advanced skills better than we have done before. Linking online resources faster and better with content in their curriculum with audio, visual and event tactile responses will imbed and better equip the students for real experiences aiding ensuring a faster transition between technical skills or knowledge to recall and execute abilities.
- E- Research: the VR industry and its applications are only now gaining momentum as technology advances so do processing speeds, visual technological capabilities and many other aspects around the technology. Since the acquisitions and interests invested by major tech companies and social media companies, so the race has begun to find corporate opportunities for application and usage. Education plays a large role in the development of the innovation but also the return spinoffs for the department and University is immense:
 - I. Educating, training and developing a demand for these technologies
 - II. Resources readily available to develop and fast-track expansion capabilities, usage and applications in different sectors faster
 - III. Research capacity and capabilities
 - IV. Test subjects and captured market analysis
 - V. Assistance in speeding up products to take to market.

- E – Commerce: the department will aid in developing products or establishing new products and services for both the internal but also external market. Essentially the innovation and technology developed will become the same tool that aids in selling or letting the end user buy the products its created, a full circle process.

For the department to be successful as well as financially viable the university has chosen a model that would essentially allow for resource collaboration in order to develop outputs (products or services) that would be commercially beneficial to each party. The capital outlay that would be required to establish a stand-alone service or product would not be advantageous for each entity, hence the collaboration and corroboration to gain outcomes faster in order to create market ready products and services. A detailed business plan with projections and contractual expectations would need to be developed to establish a memorandum of agreement or joint venture where possible profit shares and other benefits may be established. It may be that the commercial partners vested in the innovation may score more out of the deal in the long term, the main objective for the university would be investment to obtain a competitive advantage which provides digital and virtual solutions for its clients.

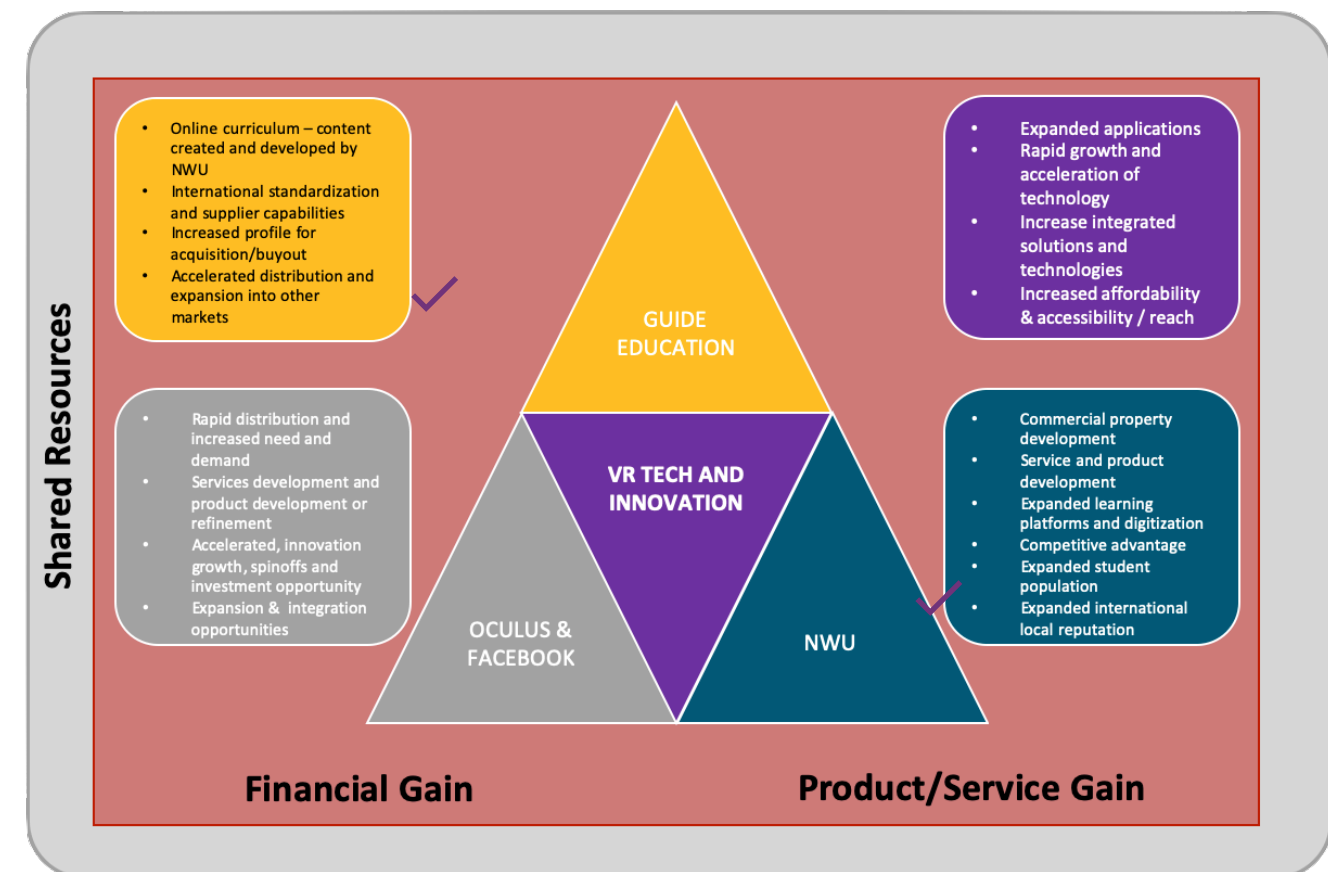
The innovation department's strategic goals are focused on a long-term period of 3-5 years:

- Be a leading and successful technology research-intensive department
- Pursue excellence in immersive, integrated and augmented learning
- Establish value adding opportunities both internally and externally with the view to commercialize and sustain the departments growth and activities
- Strengthen the department and the NWU's national and international profile through association and collaborations with global technology leaders
- Develop a sound business unity that provides and serves the universities financial and core business collectively

The department has identified and strategically aligns itself with the core values and strategy of the NWU:

- Enhance, expand and establish ease of access to content and tertiary education
- Strengthen the University's research and technological profile as a competitive advantage
- Foster and develop key relations with global partners and stakeholders
- Optimise and collaborate in order to develop and grow resources and institutional sustainability
- Strengthen the University's responsiveness and ability to adapt to technological advances and requirements of its students and greater academic community

The following diagram explains the intended relations and opportunities between each of the parties:



PART 1

Thinking of a Technological Innovation: Virtual Reality in Education

DESCRIBING THE DEPARTMENT



There are three main types of virtual reality used today to transform the world around us, including non-immersive, semi-immersive, and fully-immersive simulations (Poetker, 2019).



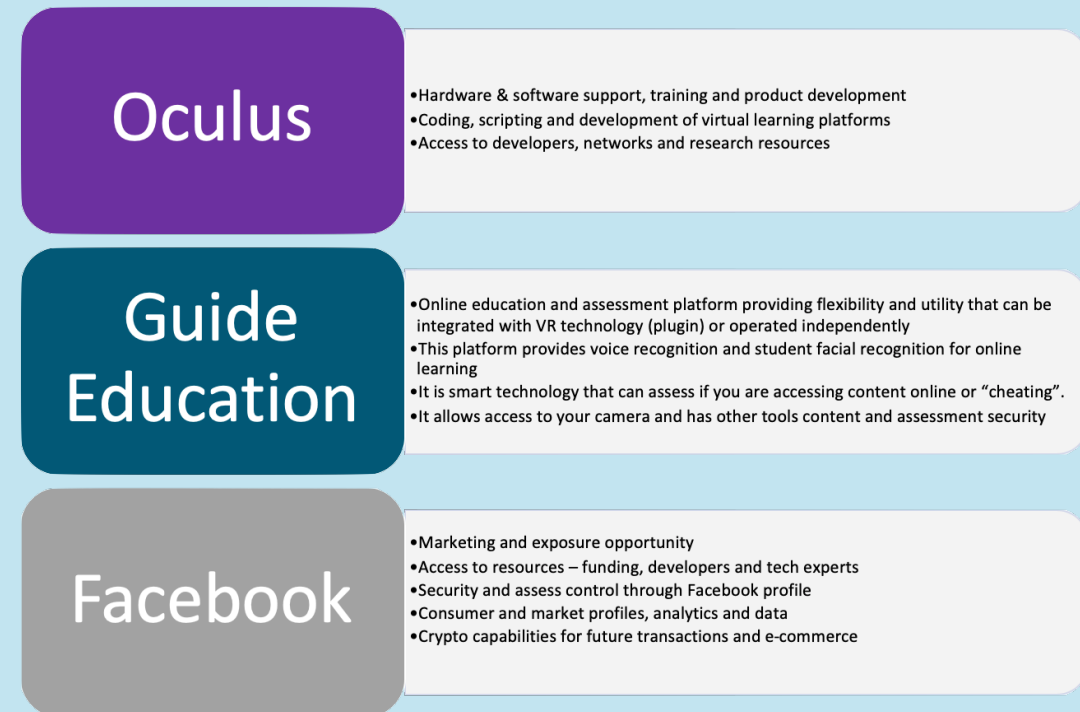
The Oculus Quest 2 - Is priced between R5000 to R7500 which makes it cost effective as online VR and computing hardware.



It is the only stand alone VR headset currently with computer and cable connectivity capabilities. Its multi camera and new capabilities no longer requires the halo's and allows for more immersive experience.

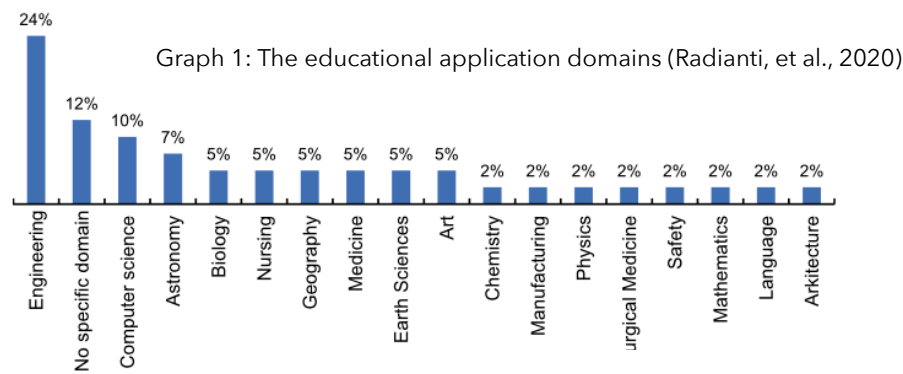


The department will aim to ensure a collaboration between core corporate and technological companies to create a platform to perpetuate innovation and development of virtual reality. It would require there cor components: the VR headset hardware, a technologically strong company and a e-education company that has resources to develop a structured learning environment for VR. The following diagram provides insights to who and what each partner would bring to the department:

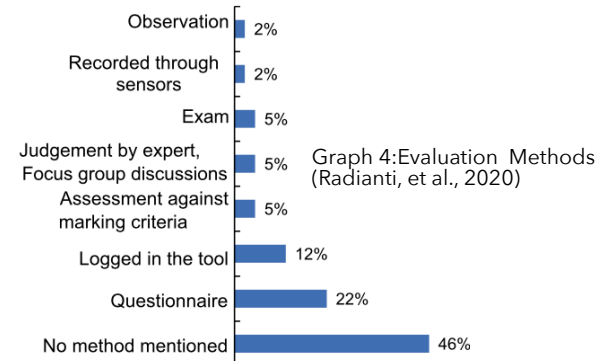
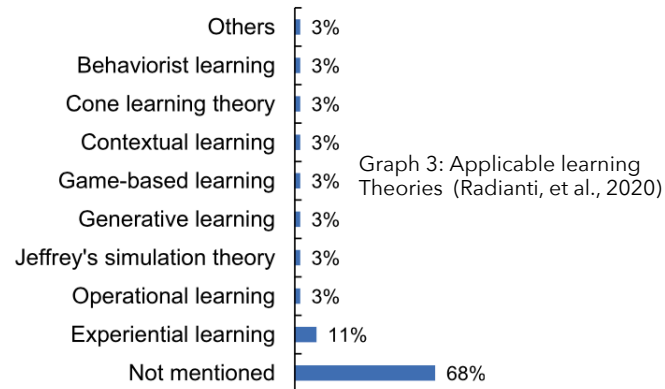


In order for the relations to be beneficial a specific bundle of products/services would be identified that would provide each of the stakeholders a unique value proposition within the tertiary education space.

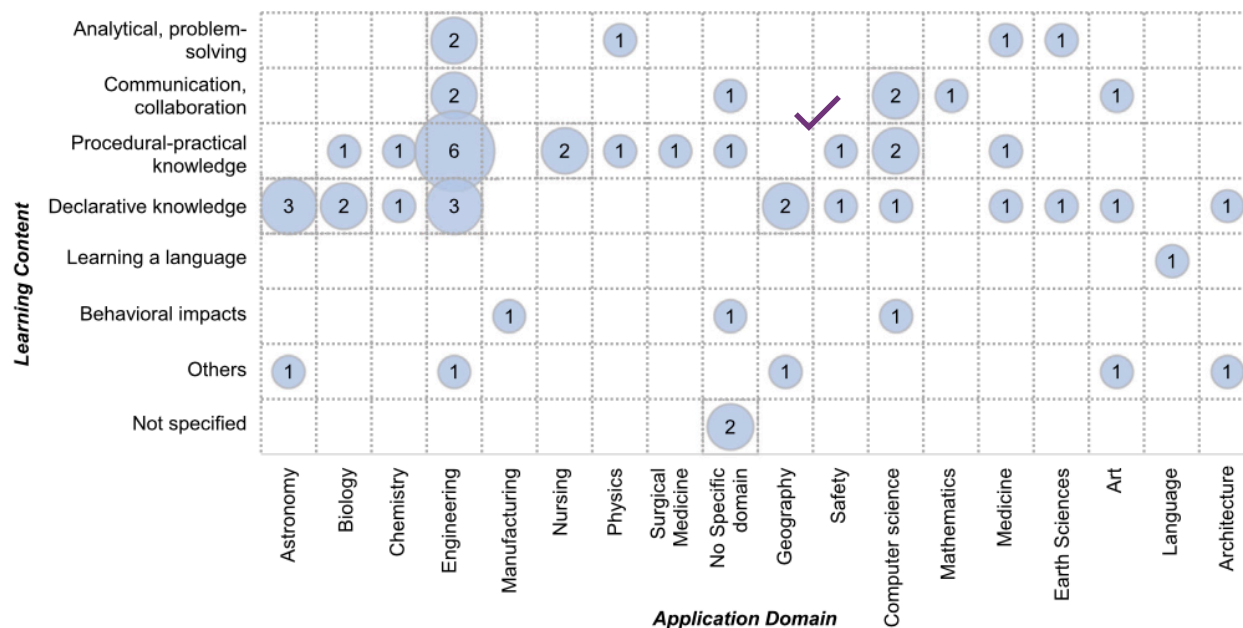
The Oculus headset is predominantly well renowned for its gaming capabilities and high quality graphics and virtual feedback from the haptic hand sets. Oculus was acquired by Facebook in 2014 for \$2.3 million dollars, with this comes the interest of facebook to develop the hardware and software for multi purpose usage. Initially Facebook's interest was to delve into the "Bigscreen" experience and capabilities, however education and technology development has been the main drive, ensuring they get their product out cheaply to the market and working closely with stakeholders to develop the product and its software, within this lies the opportunity to work with Oculus and Facebook in developing educational platforms and creating a synergy that would make this cost effective and possible for the NWU to implement.



Graph 2: Learning Content (Radianti, et al., 2020)



Graph 5: The comparison between application and content (Radianti, et al., 2020)



Below is an indication of the products and services intended for the NWU, numerous spinoffs are possible form this innovative technology and will be phased in over time:

Products

- ✓ VR Head sets
- VR & E-study material and course content
- VR Tertiary curriculum and education packages (Internationally accredited)
- Applications and assessment tools, protocols and interactive education platform integrated with VR (better than eFundu)
- Distance learning platform

Services

- Troubleshooting, maintenance and developers
- Integrated platform for resources, interactive education and communication servicing all students
- Augmented resources and value proposition for existing services like media, video and more.
- Servicing all departments academically and support (i.e. faculties, sport, marketing and recruitment)

Looking at the the intended endusers of the NWU the following customers have been identified within the tertiary education sector: the students, parents, staff, faculties, stakeholders and alumni. With competitive advantage at mind, the urgent need for digitisation in education we will further focus on the students as the primary intended end user. All other customers are directly impacted or have the potential for further product and services development.

(Radianti, et al., 2020) suggest that there are key aspects within the tertiary industry. They have focused on which potential factors within the industry would be largest impacted and what factors would need to be taken into consideration when looking at the intended target market. They Identified five main aspects namely:

- Study direction or educational application
- Learning content
- Applicable learning theories
-
- And the comparison between application and content

PART 1

Thinking of a Technological Innovation: Virtual Reality in Education

THE BUSINESS CANVAS MODEL

Internal factors

Key Partners

Customers:

- Administration
- Staff
- Students ✓
- Faculties
- Alumni
- Stakeholders

Suppliers:

- Oculus - hardware
- Facebook – software, coding/scripting and funding
- Guide Education – Curriculum & Advanced Online Education Platform

Other:

- Bursars and funders ✓
- ITC & Data partners

Key Activities

- **Education:** Immersive & adaptive, High Tech, Group, Distance and Simulation Learning ✓
- **Administration:** Recruitment, Marketing, Meetings & Training
- **Student Life:** tech culture & customized experiences
- **Innovation**

Key Resources

- Large student population
- Academic capacity & expansion capabilities
- Staff & expertise
- Infrastructure & funding
- IT & Technology
- Research capability & capacity

Value

Value Proposition

- Providing a platform to grow national & international recognition.
- Providing an engaged online learning platform that can support & solidify the hybrid system. ✓
- Creating innovative and cutting edge learning and research opportunities for the NWU.
- Providing a platform that embraces diversity & multilingual needs in education.
- Informed decisions processes through data and analytics obtained from systems
- Commercial opportunities, marketing & income generation

External Factors

Customer Relations

- Customers expect best quality education ✓
- Customers expect multi-lingual & multi-modal academic programs ✓
- Well designed & dedicated customer experience
- Affordable academic programs, materials & services
- Accessibility and data/resource friendly

Competitors

Local Universities:

- Wits
- Tuks ✓
- UWC
- Maties

Hardware:

- Microsoft
- HTC
- Vive

Software & Developers:

- Google
- VR Education
- Unimersiv

Channels

- **NWU:** course package & VR Set deliverable or collectable.
- **3rd Parties:** self purchased VR set, download application and course content with prescribed codes. ✓
- **Re – Used:** either from within a family or refurbished and upgrades models obtained and resold by the NWU at a reduced rate.

Competencies Required

- Coding, scripting and 3D animation
- Dedicated support systems and services – repairs, maintenance and refurbishment ✓
- Increased and improved ITC and infrastructural needs (capacity and load management)
- Training platforms for staff and students (can be built into hardware)
- VR expertise and skills in managing the technology holistically
- R&D department dedicated to VR education
- Dedicated administrators and logistics to distribute and aid in setting hardware up for students and staff.

Products/Services

E-Learning: ✓

- Online and interactive learning
- Distance learning (National & Global)

E-Research

- VR research and development for internal and 3rd Parties

E-Business

- VR seminars, workshops or thinktanks
- E-commerce: hardware and content creation or subscription based content.

Factors influencing Competitive Advantage

- Capital intensive process and programs ✓
- Many new startups and large corporate investment globally into VR technologies and R&D.
- Large corporates, tech and social media tycoons, self interest and development of technologies for self gain.
- Covid-19 has sped up the need for online communication, interactive and educational technological tools.
- Local competition has already signed up some big companies and tech companies, limited options available to partner with.
- Acceptance and time to adjust to augmented education. With this comes the time and energy investment to ensure adequate and approved curriculums from education departments and governing bodies.

PART 2

How to implement and manage technological innovation: Virtual Reality in Education

WHAT RESOURCES ARE NEEDED

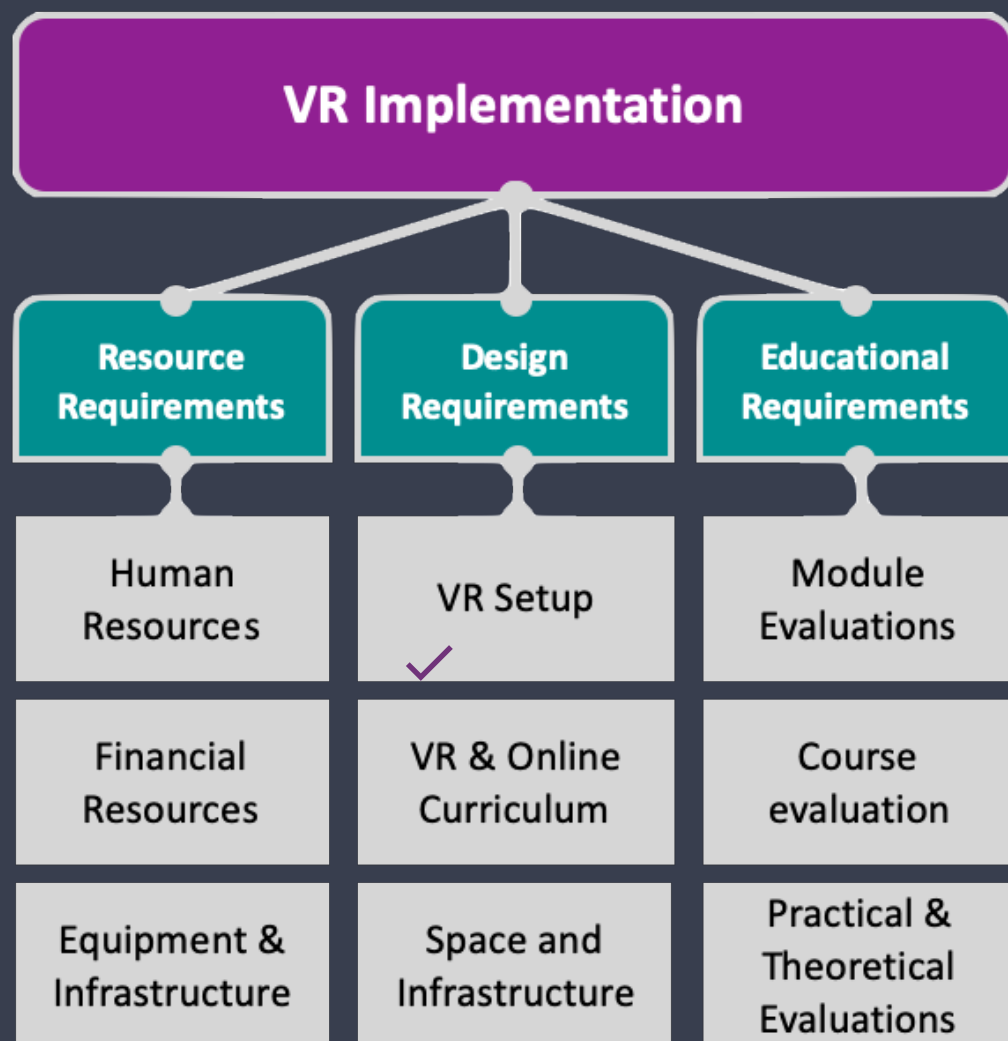


Figure 4: VR Implementation Resources

Resource requirements

The nature of the department with the intended technology will require a phased approach and development program. Essentially roll out will have to start with controlled groups to ensure efficient and effective management. Continuous analysis and interventions will be required ensuring that sufficient resources and processes are in place to develop a sustainable and large-scale role out

There are three primary categories or resources, namely: Financial, Human Infrastructure and Equipment, which are required for the implementation of Virtual Reality (VR) educational courses.

Financial: Despite the large capital investments initially to establish VR programs and infrastructure there are initiatives through self-funded, donors and re-furbished resources that will not only make it affordable for the students but will also generate income over time. Subsidization and investment from Oculus and Facebook aid in ensuring affordable technology for the students which are funded similarly to the way textbooks do and can be included in their student fees to ensure ease and the ability to reduce the initial burden, through monthly payments. Initially, the software and coding requirements for this technology will be extensive, and maintenance and upgrades will make ease the cost over time, subscription-based financial models included in the student fees can specifically be channeled to relevant curriculums and focused on key development areas.

Equipment and Infrastructure: with the implementation of this technology adaption to current infrastructures like server, network and ITC capabilities and capacity to deal with the system load will need to be reassessed and upgraded. Connection points and compatibility with existing computer labs and technologies on the campuses will need to be reassessed. Something as simple as plug/power points will need to be increased and made more readily available in order to ensure students can charge or access power in order to complete their work. Improved connectivity and Wi-Fi systems will need to be upgraded ensuring connectivity and continuity of activities.

Design requirements

Aspects to consider in the design of the department and the implementation of VR would be: ✓

- 2-2m spaces provided to ensure safe usage – this may require cubicles in designated areas in classrooms or libraries or simply dedicated open-air spaces that would cater for these costs effectively. ✓
- The implementation of this technology must be efficiently optimised to serve several departments and university requirements. This would mean that departmentally one would require individual/s to manage the roll-out and programs effectively.
- Establishing key collaborations between departments is essential, ensuring the look, feel and programs provide a similar customer experience. Also, the opportunity lies not only in academics but also in sport, arts and culture as co-curricular activities offered at university and impacts student life.
- A combination of internal and external experts will be required in order to ensure that best services, inputs and outputs are generated. The suggestion to work with Guide Education and Facebook allow both investment and return, which helps provide resources and opportunities for the NWU to explore and develop in VR. ✓

Several interdepartmental collaborations will be required in order to ensure a successful roll-out plan and implementation of the VR and Online Technologies. Examples would be Facilities and Infrastructure, Finances, IT, Education, Student life, Faculties and many more.

Educational requirements

When the resource and design requirements are compared to each other as in (Radianti, et al., 2020), one can see the relationships and design elements that correlate indicating an immediate need for: ✓

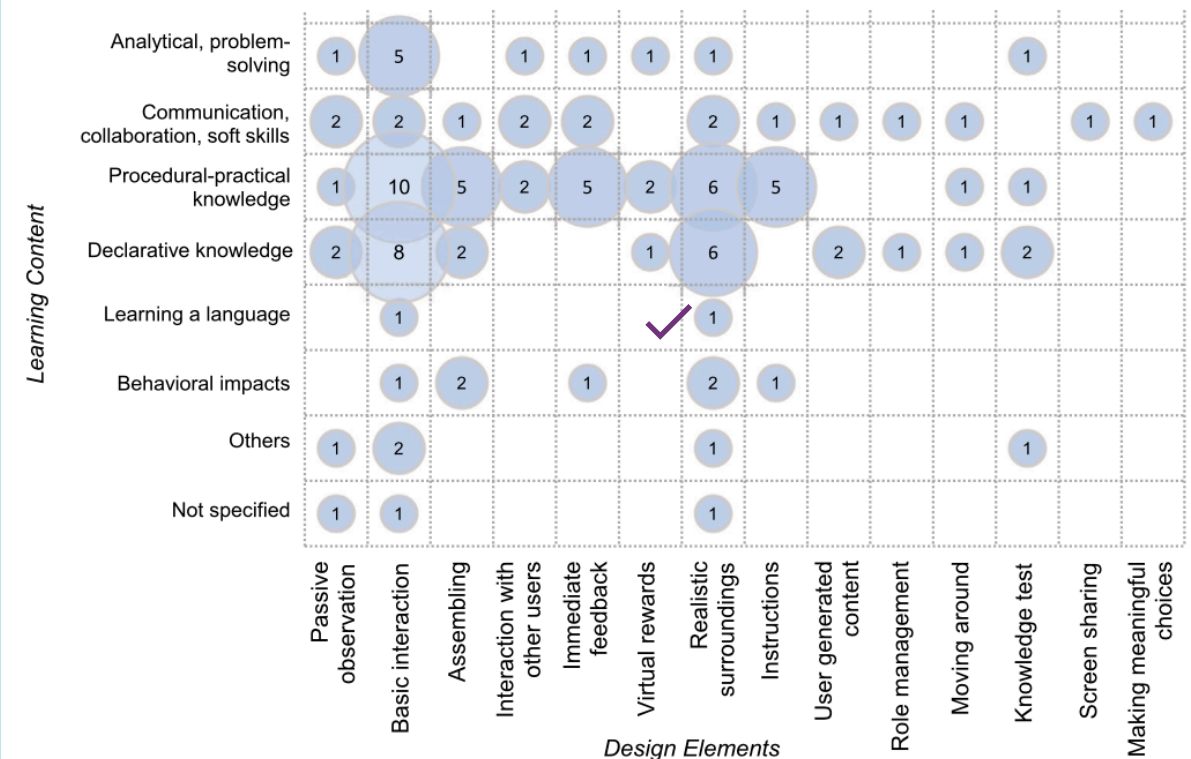


Figure 5: Relationship between learning content and design elements. (Radianti, et al., 2020)

- **Basic Interaction** - allowing communication, online education and access to practical knowledge, skills and problem-solving solutions. These can either be through tutorial-based activities or “Zoom” like interactions with staff. ✓
- **Immediate Feedback** - this can be generated through algorithms or quiz-based feedback opportunities. Due to the capabilities Audio, Visual and Tactile feedback would allow one to make the experience more real or significant. ✓
- **Realistic Surroundings** - through simulation capabilities or technology and access to databases, one can easily simulate the surroundings and potential environment through VR. These experiences impact the brain and create a better virtual experience that is stored easier in the brain. ✓
- **Interactions** - class-based activities can still take place virtually or digitally through the software. This allows for group work or Q&A sessions within the learning environment. Even avatars are possible to imbed their

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How to implement and manage technological innovation: Virtual Reality in Education

HOW TO SUPPLY RESOURCES NEEDED



Education is expected to be the fourth largest sector for VR investment, Silverman (2019). VR in education is predicted to be a \$200 million industry by 2020, and a \$700 million industry by 2025.



97% of students would like to study a VR course. While only about 7% of teachers regularly use VR technology, almost 80% have access to it, 93% said that their students would be excited to use it, 70% want to use it to simulate experiences relevant to course material, and 69% would allow students to use VR to visit distant locations, Silverman (2019)

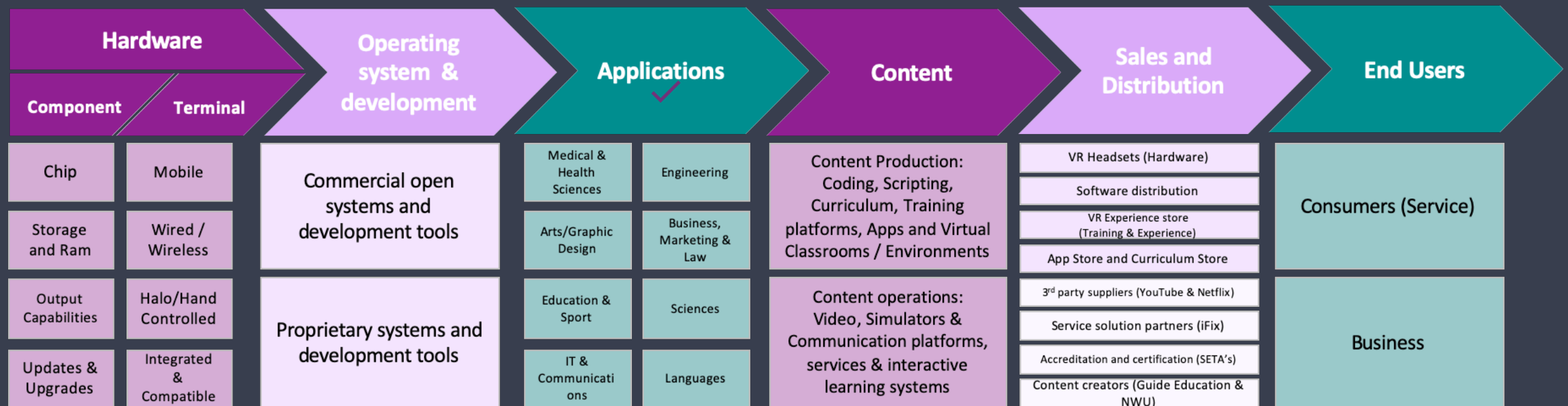


Figure 6: Combined VR Value and Supply Chain

The VR value and supply chain is a diverse ecosystem where the Oculus technology passes through a process of product identification, application abilities and content generation are matched, ensuring value to the end-users.

With a leading tech company as Facebook and an online education company like Guide-Education, one can complete the value and supply chain, from interactive devices, terminal platforms and developer tools to distribution platforms, where content is either produced or refined from the inputs provided by the NWU for internal use or external clientele.

Influential developers and associates can attract many third-party interest and development that will aid in sustaining the R&D section within the department as research and projects can be sold off or supported financially generating numerous advantages for the ecosystems. For Facebook and other leading online platforms, the consumer reach and application represents more significant opportunities and advantages this is why Facebook acquired Oculus, with a short term view of distributing and creating the demand, whilst creating a long-term need for software and other applications.

Facebook was accused of trying to take it all however the opportunity to have both an online platform that supports, aids and develops hardware that changes the world is no different from other competitors, this unique value bundle supports the concept well and ensures a long sustainable future during and post Covid-19. Many of them have invested heavily in both software and hardware. Diverse demands and applications from a Tertiary environment not only aids education but also changes a culture post-education. This perpetuating change and the development of technology into other fields of business and society, unlocking this potential for Corporate Tech companies is valuable, hence why Facebook sees the complex platform and integrated opportunities which the NWU would be able to unlock for them. The NWU may be seen as a guinea pig but the spinoffs and competitive advantage that will not only secure a university structure but create a quantum leap nationally and internationally.

The business market consists of diverse segments and complex requirements; the NWU would benefit from interaction and research to develop solutions and services for different sectors. Programs and software solutions are easily adaptable to remain up to date or provide educational and business opportunities, sustaining not only the department but faculties and their departments. The technical skills and practical experiences generated from these types of programs may be easier to audit, validate and accredit through SETA's and other governance or accreditation bureaus. This provides detailed training and ensures a higher quality of education and student released into the world.

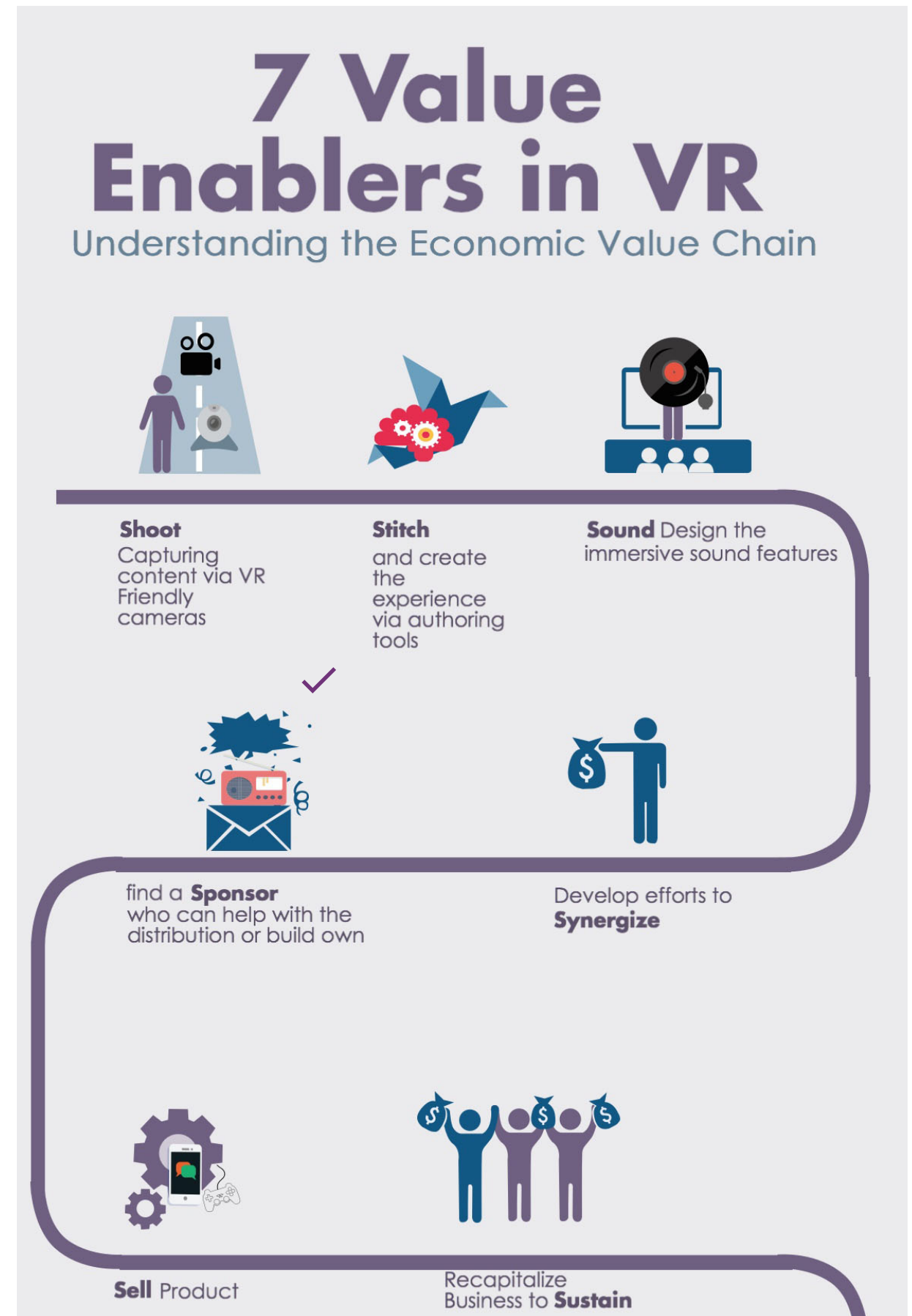


Figure 7: 7 Value enablers in VR (Virtual Reality, 2015)

PART 2

How to implement and manage technological innovation: Virtual Reality in Education

DETERMINE THE TIMING OF INNOVATION AND HOW TO LAUNCH IT

Preparation Phase:

Firstly, the organization will need to expose the students to VR via online discussions, marketing campaigns and promotions. As this is a new technology, students need to be convinced that they will be able to use it for any aspect of the course. The headsets will also need to be ordered and the necessary coding and software needs to be added to enable full functionality. This step can be timeous and needs to be planned precisely. It will also depend on the availability of the headsets as well as the amount that needs to be ordered. This can take approximately three months. The coding will also take time. We can set aside approximately 6 – 10 months for this step.

Training Phase

The students need to be taught how to use this technology especially if they are not familiar with it. There will be a built-in tutorial on how to use the headset and the remotes. A plug and play booklet will also be included in the startup kit that the student receives. The student will get their package at least a month before the classes are set to start to ensure that they fully understand how the technology works.

Testing Phase

Before this technology can be advertised it needs to be put to the test. A group of pilot students need to be selected to test if the software and hardware is in full working condition. These students will need to perform various tasks as set out in the course outcomes. This can take up to a month to test and fix all the problems. There will also be continuous testing and improvement throughout the whole course.

Feedback and Remedies:

All though remedies and feedback is continuous, there will need to be time calculated for this as well as a quality check post the the first three phases before the final roll-out. It is important to ensure that effective checks are put in place throughout the process.

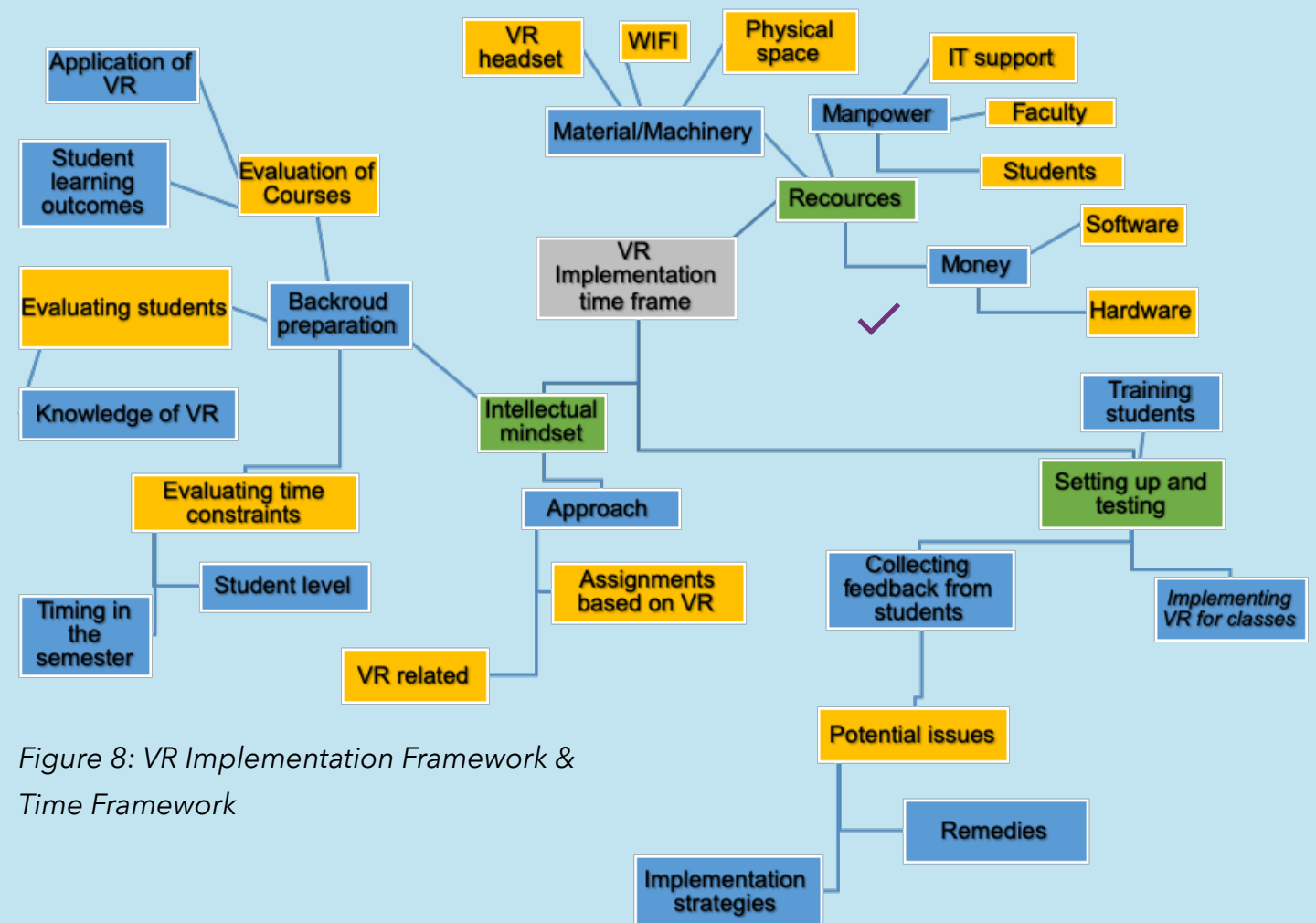


Figure 8: VR Implementation Framework & Time Framework

TIMING OF INNOVATION AND LAUNCH PLAN

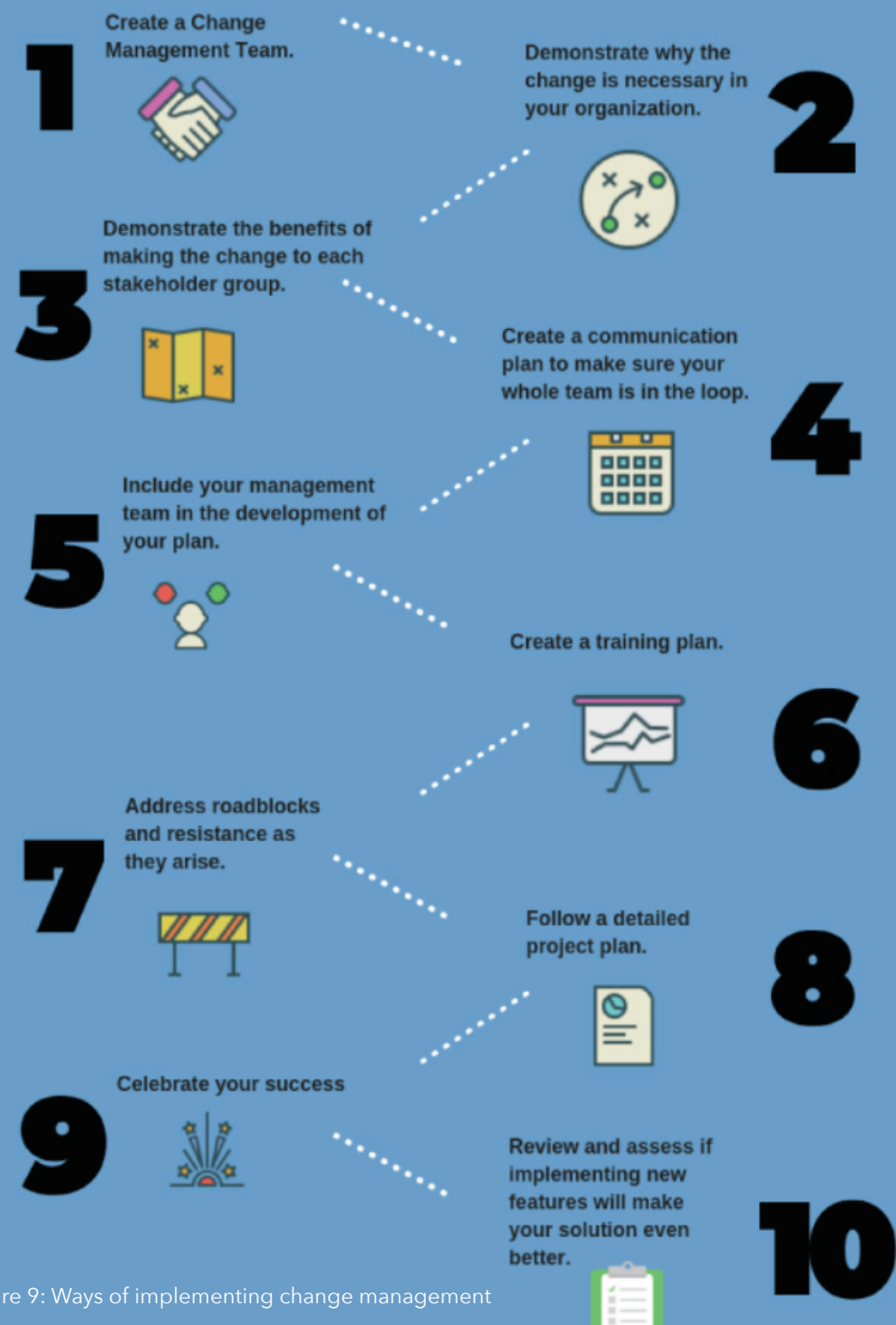
	Marketing	Marketing Communication	Lead Generation	Internal Communication	Demo or Launch
Internal launch	Marketing and Communications: - Media, Intranet and Web Plan - Social Media Plan - Communique Plan - Channels of communications and collateral plans Stakeholder Relations: - Activation plan - Inter campus awareness plans - Student radio and media plan - Inventory and marketing material plan - Brand Plan - SASREA (legislation)	Internal (MarCom's, Mar, SHR, IT) - Product launch/ event plan - Advertising and marketing schedule - Media and social media schedule - Promotions schedule - User group engagements and invitations - Press releases - Advertising and marketing materials - Product positioning	Internal (Marketing, SHR & IT) - Stall discounts/ specials or promotions - Lead capture mechanisms - Promotion strategy - Success metrics and Kpi's - Customer experiences capture	Internal (MarCom's, Mar, SHR, IT) - Communications Mechanisms established - Special events plan - Product usage, tests and dry runs - Collateral/mitigation plans - Final checklist & site visits	Internal (MarCom's, Mar, SHR, IT) - Demonstrate the working of VR systems at the final launch - Branding - Stalls or display units - Feedback (surveys, interviews etc.) - Marketing materials and gifts - Displays and visual aids (Media content/presentations) - Training and product specs/sales points - Staffing
External Launch	External PR company: - Media Plan - Social Media Plan - Channels of communications and collateral plans Internal (Marcoms and SHR): - Activation plan - Internal media resources plan - Awareness campaign plans - Inventory and marketing material plan - Brand Plan - SASREA (legislation)	External PR Company - Product launch/ event plan - Advertising and marketing schedule - Media and social media schedule - Promotions schedule - User group engagements and invitations - Press releases - Advertising and marketing materials Internal (IT & Marketing) - Product positioning	External PR Company: - Stall discounts/ specials or promotions - Lead capture mechanisms - Promotion strategy - Success metrics and Kpi's - Customer experiences capture	External PR company: - Communications Mechanisms established - Special events plan - Product usage, tests and dry runs - Collateral/mitigation plans - Final checklist and site visits Internal (IT) - Product usage, tests and dry runs - Collateral/mitigation plans	External PR company: - Branding - Stalls or display units - Feedback (surveys, interviews etc.) - Marketing materials and gifts - Displays and visual aids (Media content/presentations) - Staffing Internal (IT) - Demonstrate the working of VR systems at the final launch - Training and product specs/sales points
Responsible (Internal departments)	Louis Jacobs (MarCom's) Rene Vermeulen (SHR) Johan Pyper & Andre Swanepoel (Mar)	Chief Dir. IT Johan Pyper and Andre Swanepoel(Mar)	Rene Vermeulen (SHR) Chief Dir. IT Johan Pyper and Andre Swanepoel(Mar)	Rene Vermeulen (SHR) Chief Dir. IT Johan Pyper and Andre Swanepoel(Mar)	Louis Jacobs (MarCom's) Rene Vermeulen (SHR) Chief Dir. IT Johan Pyper and Andre Swanepoel(Mar) Internal Catering Mark Greef (infrastructure) Servest & Tsebo Giel Senekal (Security)
Time Frame	6 months to D-day	4 Months to D-day	2 Months to D-Day	4 weeks to D-day	2 weeks to D-day

Table 1: NWU innovation launch plan and time schedule

PART 2

How to implement and manage technological innovation: Virtual Reality in Education

HOW TO MANAGE THE CHANGE



Change in any organization is complex and intricate as it involves many moving parts. It's human nature to object and resist change as an imbalance or insecurity triggers instinctive reactions to protect and preserve. Change management is the expression used to define the complex of activities, functions, and tools (such as training courses) through which an organization deals with the introduction of something new that is relevant for both its survival and growth. (Sartori, March 2018).

There are various elements companies can use to ensure that change in innovation and technology occurs and achieves success. The following methods will provide this:

- **Training and development:** through this measurement companies can empower the competencies of the employees, workers and managers to ensure long term growth in each person. Through the development of these competencies employees in their capacity can effectively handle changes in their lives and workplace. In terms of organizational innovations, it's the process of transforming ideas and innovation into goods and services that can generate value for the customer. Through the implementation of VR headsets, the value of personalized education per student is generated. Through a process of open innovation, the co-operation between employees, teams, groups and organizations will occur, and for the change in technology and innovation to be successful proper competences needs to be present. For the successful implementation of the headset, there would need to be full co-operation between the company Oculus, NWU staff, students and any other parties involved in the implementation of the new technology.

There are some training techniques companies can use to ensure success for the future with innovation:

1. **Encourage a high feedback environment:** ensuring an environment for feedback is crucial to the success of the implementation of new technology. Through good feedback, environment employee will participate more actively in their role in the process and ultimately build a foundation for relationships between the tasks and the company.

Figure 9: Ways of implementing change management

2. **Involve customer success:** standard practice is to display success stories to customers to secure new sales. This method can also be used to show employees the success of the product and push them to want to understand the product better. The interaction and success stories of customers will alleviate doubts or fears that employees may have.
3. **Blended learning:** is the process of learning through various means that has the right mix of different types of learning available. From online courses to the instructor, led training is the best mix and is crucial for the best results.
 - **Teamwork:** was considered to be one of the primary guarantors of a project's success is teamwork in the past. Success today is defined by organizational intelligence in business. This goes further than a single individual, encompassing the environment of an organization wherein a team works, including the experience and skills that are required to make a project work. Collaboration is necessary for this department, and a new technology start-up can have its challenges as people working in different areas and on various aspects need to be coordinated. Communication tools are thus a critical factor in the success of teamwork. A clear strategy and vision are required to ensure clearly defined roles and responsibilities, giving purpose and direction. It would be an excellent idea to workshop the strengths and the weaknesses of the team, so individuals know where to work harder or corroborate on. In the implementation of the new technology VR Headset, all departments will be critical in the success of the project, and it will be imperative for the R&D team to establish wish lists and categorise them into short to long-term opportunities or objectives. Many views provide perspective and allow cross-pollination of concepts that will give not only insight for the NWU but the stakeholders, Facebook and Guide- Education. This not only provides value but ensures a vested interest and motivation to achieve success.
 - **Motivation:** An essential aspect to the success of implementing innovations or new technology; however, there are gaps when it comes

to the understanding of the processes involved. From these gaps, there may be resistance to adopting newly implemented innovations. Employees feel threatened through new technologies as they feel unstable, insecure and uncertain of what their purpose will be in the future. Motivation will help to limit these feelings. These aspects of motivation can help employees to have a better understanding and answer the issues that employees have can be achieved through the following ways:

- I. *Keep the new technology simple and easy:* This will allow for quicker adoption and adaption to the innovation.
- II. *Connect to the employee's needs:* This will allow an apparent personal gain to be understood by each employee if they know and accept the new innovation.
- III. *Share tool ownership:* This will allow employees to be present from start to finish and show them the added value or supplement to their job skill rather than a substitute for their job skill.
- IV. *Group endorsement:* A collective agreement is a powerful tool. Having a group of employees effectively and successfully using your new technology will lead to faster implementation across the university
- V. *Tailor training:* This aspect is crucial as every department is unique aspects at the university. Tailoring the training relevant to the department is essential to the success of the new VR technology.

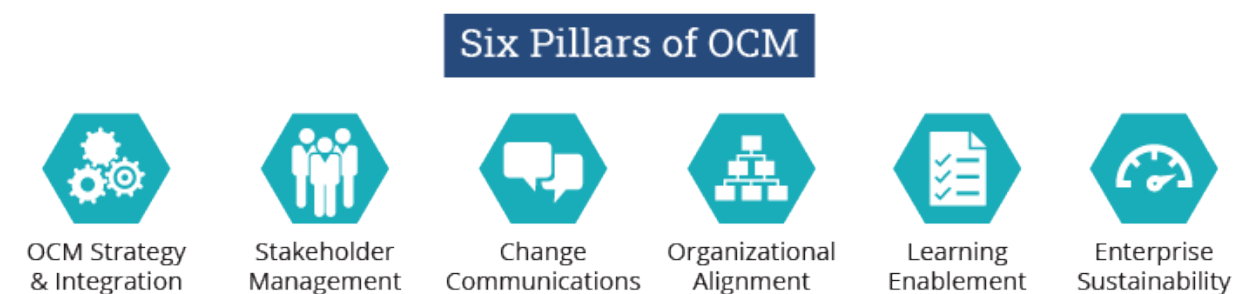


Figure 10: Six pillars of change management

- **Leadership** - Leadership plays a critical role in the successful implementation of technological changes. Leaders must ensure that employees understand the need for the changes and how they should be implemented. Effective leadership focusses on the outcomes of the innovation implementation. It provides guidance and direction throughout the implementation phase while building relationships of trust that allow for an open environment where debate and respect for each other are present. There must be a trust factor present between the R&D department and each faculty at the NWU when implementing the new VR technology.
- **Values** – Awareness creation of the direct value that the new technology will have for employees and trust them to be invested in the success of it. The correlation between each aspect of the university environment and feedback increases the value concept. Each faculty must be able to give accurate feedback on their feelings as to how the new technology is working for them. This aspect also forms part of good lines of communication.
- **Culture** - Technological innovation is more than investing in tech. It means preparing your team and fostering a culture that embraces the digital revolution. There are a few aspects that the R&D department can adopt to drive a culture change:
 - i. Alignment of the culture with the R&D departments strategies and process – present the vision, mission and values with the HR processes including hiring, performance management, benefits, promotions and compensation for employees.
 - ii. *Connecting culture and accountability* – by taking responsibility for one's work success can be better achieved.
 - iii. *Visible proponents* – lead from the board down. Showing employees that management is 100% on board will drive employees better.
 - iv. *Define the non-negotiables* – define those areas present in the culture that will stay and inform those aspects that will fall away. These aspects must be non-negotiable.
 - v. *Alignment of the brand and culture* – full alignment of all faculties and departments is crucial. For example, R&D needs to align with marketing and HR if the new technology is going to be a success.

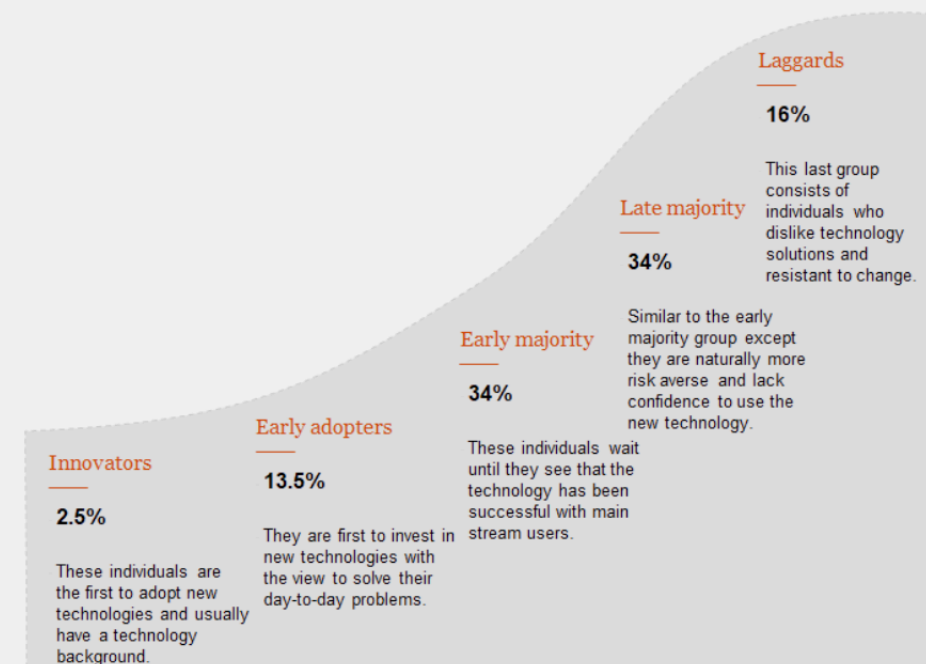


Figure 11: Illustration of the "s-curve" adoption model for VR Technology (PWC, 2020)

PART 2

How to implement and manage technological innovation: Virtual Reality in Education

THE NEW ORGANIZATIONAL STRUCTURE

The current structure of the NWU Information Technology Project department/facility is where a new R&D innovation department will be implemented. The physical structure of the IT department won't change too much when the implementation of an R&D department occurs. The R&D department will simply fall into the system currently present. The current organizational structure present is a Divisional organizational structure. Shown in the drawing is this fact. The IT department stands alone, and they are in control of their own resources and operate as a separate business at the NWU. Once the new VR technology has been installed, the IT department can virtually sell the new technology to the other departments present at the NWU and generate income. They would then look to structure a marketing and sales team in their organizational structure, but this is to be established at a later stage once the New VR technology is fully functional.

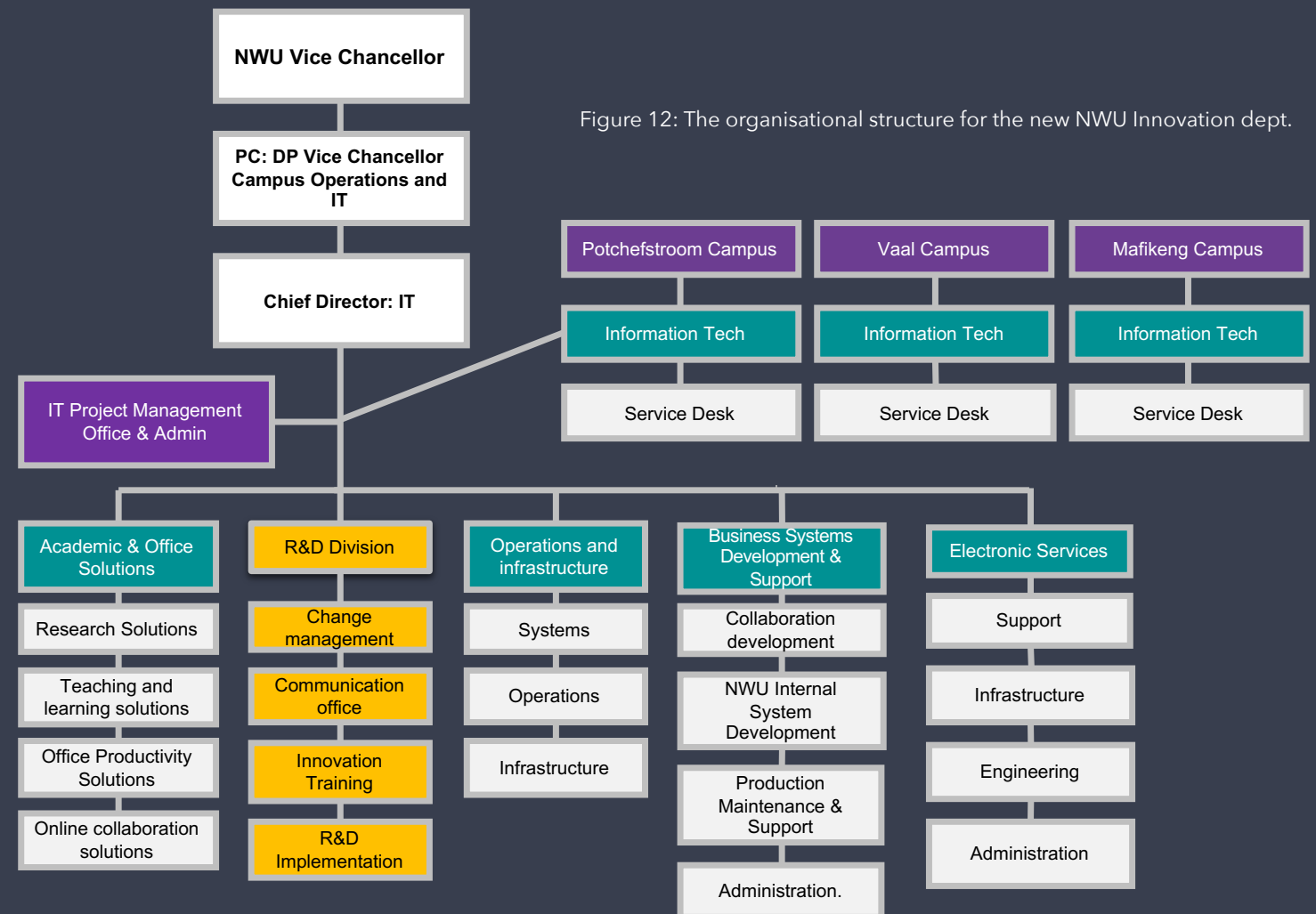


Figure 12: The organisational structure for the new NWU Innovation dept.



PART 3

How to institutionalise a technological innovation for the future: Virtual Reality in Education

SUGGESTIONS FOR ORGANIZATIONAL RESTRUCTURING

VR IN ENTERPRISE

- Training new recruits is a difficult and time consuming task. Virtual Reality is used to tackle this problem by making learning more interactive and immersive.
- It will drastically reduce the costs, save time and build the best employees for your enterprise using VR.



VR IN EDUCATION

- Education is going to be the 4th biggest sector for VR investment. 97% of the students like to study in VR.
- Giving an immersive experience for kids will create long lasting impression in their minds.



VR RETAIL AND SHOPPING EXPERIENCES

- Imagine a real life shopping experience by the comfort of your home. You can try outfits using digital avatars of you and shop the one you like.
- Many big giants like Mercedes, Oreo, Expedia, Lipton, Clash of Clans and many others have embraced virtual reality as their advertising weapon.



VR IN SOCIAL MEDIA

- Virtual Reality got a great deal of attention when Facebook acquired Oculus for 2 billion dollars in 2014.
- Be in a meeting and conferences that gives better chance of understanding and communicating and eliminates the need to travel.

Below is a breakdown of the overall approach and strategy of the North West University

Mission: The NWU subscribes to the values of human dignity, equality, freedom, integrity, tolerance, respect, commitment to excellence, scholarly engagement, academic freedom and justice.

Vision: To be a pre-eminent university in Africa, driven by the pursuit of knowledge and innovation. ✓

Strategy: To transform and position the NWU as a unitary institution of superior academic excellence, with a commitment to social justice.

Goals: To be an internationally recognised university in Africa, distinguished for engaged scholarship, social responsiveness and an ethic of care.

Aligned IT Strategy: To build NWU digital Ecosystem consisting of Infrastructure, services, solutions and transformational support with modern practices, motivated and capable people. Stakeholder engagement and partnerships to build awareness.

The aim is to be **technology market differentiators** to be the best in class information and communication technology. Some examples include supported e-learning, e-research and e-business.

Virtual Reality (VR) in education was selected as the most suitable and appropriate technology to help North West University to achieve their goals and remain competitive, improving current educational systems and processes through continuous innovation. This will lead to new market opportunities in future, especially taken into account this challenging Covid-19 environment.

Organizational restructuring ideas for NWU to keep the firm innovative

An innovative spirit is a mindset that actively seeks change rather than waiting to adapt to change. In other words, it's a super-positive mindset that embraces critical questioning, creative and continuous improvement. It's about taking ownership and pride in your organization (Chung Tai-Wai, 2016)

Below some suggestions proposed for the tertiary institution on organisational design and execution to keep the firm innovative, refer to figure xxx in Part II for more clarity on departments and physical layout:

- a) Strategic adaption and autonomous leadership roles with an accountable, transformative outlook to stimulate innovation and coach in the data driven organization
- b) Senior level management to adapt their leadership style to best fit organisational change, direct initial changes and remain committed to new work practices;
- c) Creating an innovative, supportive and fully integrated digital culture and partnerships where successes are celebrated. This will enhance an innovative team spirit. Also give the opportunity to learn from mistakes; and explain the role of each person in the process to get buy-in.
- d) A strategy aligned organizational structure and success management model that clearly states the Institution value proposition, with
 - i. Interdisciplinary collaboration;
 - ii. Integrated functioning and coordination; and
 - iii. Lean and flat structure formation, defining clear roles and responsibilities that encourage rapid, autonomous decision-making, flexibility and delegated authority. The prevention of silos to ensure collaboration, cost effectiveness and organizational sustainability and conservative control (Backer, 1993)
- e) Creating a networked, virtual and collaborative learning environment
 - i. Twenty first century, transformational skills: Improve digital-age literacy, creative thinking, communication, collaboration and problem-solving ability
 - ii. Enhances traditional curricula to enable diverse learning needs
 - iii. R&D to be focussed on a whole ecosystem which include applications and educational content, social network and creating spatial

experience interfaces with the right infrastructure, solutions, services and support systems for learning, teaching and admin;

- iv. Raise the level of engagement, enabling multi-sensory learning, self-learning;
 - v. Improve substantially memory recall of lists with categorically similar items where the teacher encourages the student to reflectively construct their own internal space (Zarzo, 2015)
-
- f) Adapt new procedures and policies to fit organizational forms (Godard, 2004);
 - g) Curriculum clarification and step by step adaption prioritising certain practical departments, i.e. Lab work, engineering etc.
 - h) Have the necessary resources to implement, support and sustain the new work practices, as example:
 - i. Business internal system development and R&D;
 - ii. Software dedicated department with software architect, lead programmer, software engineer and vision engineer etc.
 - iii. VP Product Hardware department with web developer (if required), senior product manager, community manager, web engineer and hardware engineer;
 - iv. Electronic services;
 - v. An office manager and service desk;
 - vi. Digital supported platforms; and
 - i) Invest in extensive training by experts with formal assessments to demonstrate care and growth (skills, knowledge and behaviour) to be included;
 - j) Modern practices and automated processes with modernize ERP to solve real-life problems; and
 - k) Core people practices with aligned award and recognition systems to encourage innovation.

Facebook Re-structuring approach (Matney, 2018)

Due to alignment and coupling with supportive supplier approach with Oculus and Facebook, we addressed the restructuring that recently took place at Facebook. See below: ✓

- TechCrunch aligning divisional structures around **technology areas of expertise**, as example VR/AR to eliminate redundancies and ensure specialist collaboration for long-term sustainability;
- Oculus have John Carmack as CTO, Head of PC VR as Nate Mitchell and Andrew Boz in the hardware wing to run more effectively;
- They also focus on a Non silo approach to ensure that new ideas, approaches and advancements reach other teams;
- They have support teams to assist with. i.e. wi-fi, mobile, headset and PC and other technological challenges;
- They align and focus on cutting edge technological innovation: Continuous innovation of next generation computing platforms;
- A great deal of focus is places on networking and forming successful partnerships that support i.e. software, hardware and any technology related aspects;
- They have an effective ✓ shipment department to ensure fast turnaround times;
- Facebook build in an additional layer of oversight during 2016:
 - I. CEO Mark Zuckerberg; and
 - II. VR/VP lead - Hugo Barra, in charge of company's consumer hardware with Oculus as a central pillar;
 - III. Coordination efforts around more general lines like hardware and software allowing insights to flow more intuitively across Facebook's planned devices to maximise efficiency; and
 - IV. They have clearly defined roles and responsibilities.

Supporting processes:

Below framework was used for the identification and technological innovation selection purposes. The main focus was linked to customer wants and needs as per Business Model Canvas in Part I.

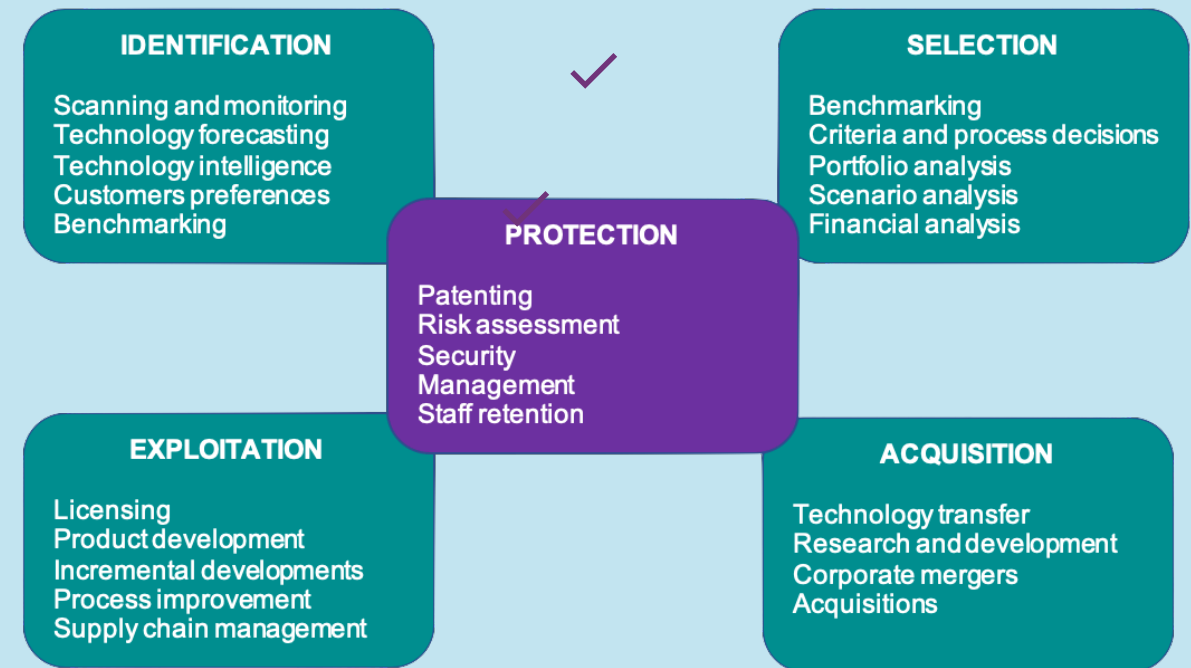


Figure 13: VR technology management framework

NWU want to make a difference, and add value to their customers as indicated per business model canvas in Part I. Disruption is a great opportunity to be revolutionary and agility adoption is key as organisational; strategy for development.



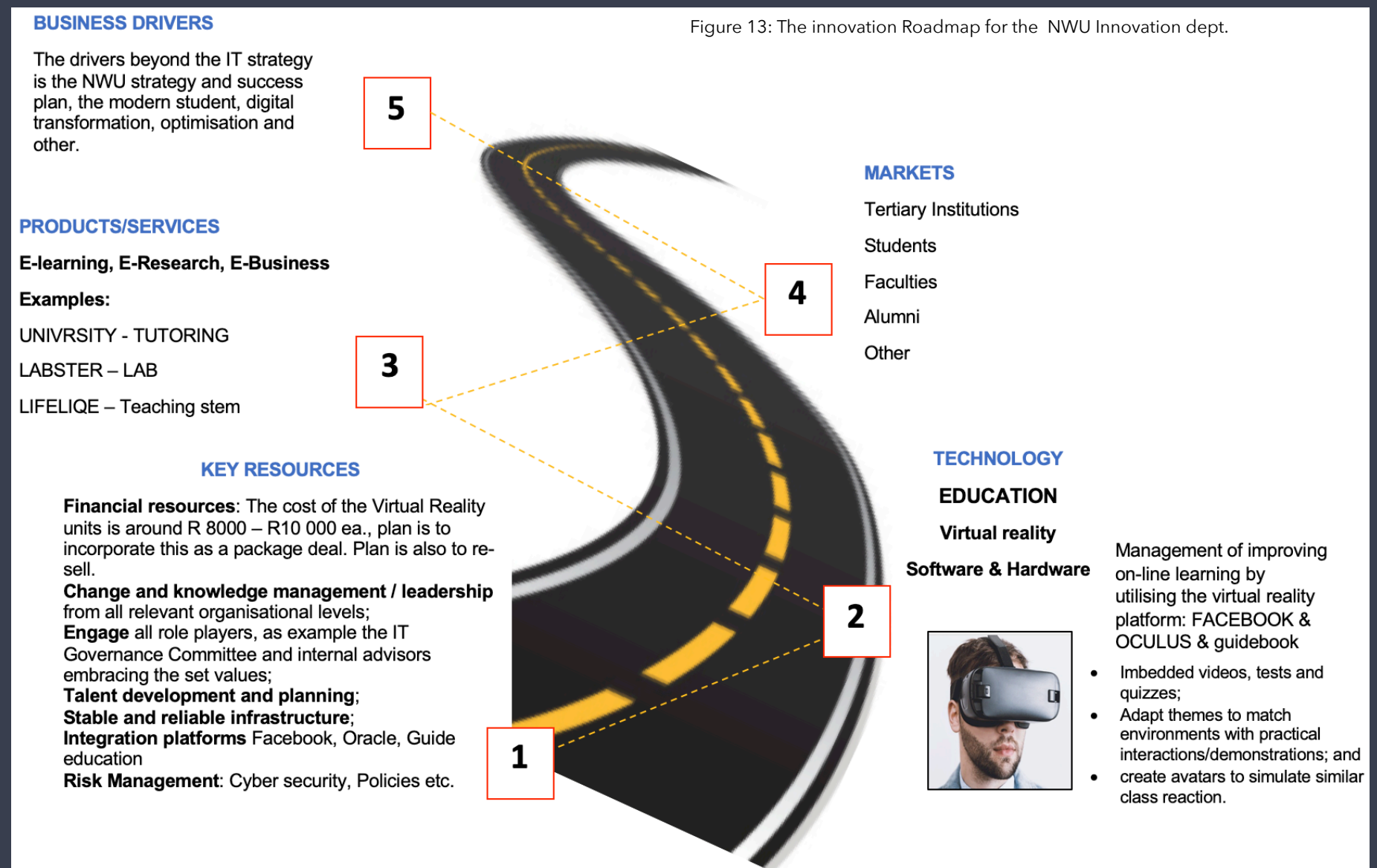
Technology innovation involves three main processes as per Table 2:

Input	The main process	Output
Factors considered: 1. Technology trends and developments 2. Customer wants 3. Market competition 4. Regulations	Identification processes: 1. Scanning and monitoring 2. Technology intelligence 3. Technology road mapping 4. Customer wants 5. Technology identification 6. Preliminary studies 7. Validation ✓ and verification for new services and technologies	Technical team requirements: 1. Technical requirements, specification and criteria research; 2. Verifying the ability for hardware, new support services etc. 3. Access readiness of existing state and elements like ✓ Infrastructure - Configuration - Accessibility - Management and security - Devices and equipment - Location - SDD - Vendors - RFP

Scanning and monitoring of the external environmental conditions, using Porter five forces should be done on a regular basis to maintain focus and to lay out the relevant context. This help with strategic alignment. Communication is key during this process.

Technology intelligence is both explicit and implicit. See below the innovation roadmap Figure 14: used as particular method/tool for technology planning within a framework. This relates mostly to physical and service product planning in early stages of the new department development.

THE INNOVATION ROAD MAP



Extensive market research was done to define opportunity and challenges in tertiary education, this will further be monitored as the process evolves.

Constant customer and vendor involvement and collaboration remains essential to be up to date with preferences. More in-detail preliminary studies will follow to ensure that exact needs of customers are addressed and the marketing research team will present feasibility studies, forecasting studies and other relevant material not presented during the Portfolio of Evidence.

Effective integration of information technologies, like Virtual Reality (VR) into the curriculum will require careful planning and numerous resources. In addition to the technology itself, there are issues such as faculty development, instructional design, learning space integration, as well as governance, policy, and ethics." (Educase, 2019).

Below are some topics/ techniques and goals of institutional collaboration among faculty, staff, and technologists for implementing services that can serve to support new learning spaces. They include faculty liaison work and faculty instruction with Virtual Reality, storing and archiving VR content, classroom support for VR, and building and infrastructure for supporting student creation of VR content. Sub-themes explored will include: cyber-infrastructure architectures, applications, and deployments; infrastructure and service design; and collaborative and participatory information environments. Also refer to <https://www.guideeducation.co.uk> to review guide education.

Table 3: Virtual Reality (VR) topic areas

Source: University of Illinois (2019)

Topic	Description
3D and VR Archiving students	- Creating 3D content for courses and workshops, ex 3D models and VR scenes; - Some technical barriers; - No existing platforms to easily capture; - Best practise preservation of 3D/VR still in progress, requiring infrastructure; - VR content in browser requires web-native technologies, or ported build of source; - Tools and resources to embed galleries and preserve and publish source files , i.e. Python, Sketchfab, Box, and a lightweight server.
Classroom Support Classes incorporating VR content	Utilize a variety of platforms: - YouTube 360 videos; - Locally created custom VR environments; and - Infrastructure and support needs: Library to serve as a consultation service for providing expertise to faculty wanting to develop custom VR content.
Design Support VR Content creation presents a diversity of options	- Providing hardware and proper planning of student design spaces; - Challenges of producing VRcontent; and - Access to 360-degree cameras in content creation of VR
Research and Instruction	- Barriers will arise as a result of the incorporation of emerging technologies into curricula; - Librarian liaison role to support this section; - By providing accessible instruction in the library, a basic understanding of VR can be built to help faculty, staff, and students of all technical levels develop enough of an awareness of VR that can lead to new opportunities for research, instruction, collaboration, and education.
WebVR Student Project	Library: - Encourage participation from all technical experience levels (from VR beginners to those well versed in VR); - Offer an entry point to programmers and non-programmers alike in democratizing VR access; - WebVR specification is our entry point allowing students to access VR experiences without requiring high end headsets; - VR project team pilot the methodologies needed for creating a 360-degree WebVR tour in of the Undergraduate Library, and provided starter code and documentation for building out a larger project in the Main Library
Organizing for VR support	- Development of campus partnerships; - Focussed collaboration on identifying resources and expertise; and - VR/Facebook website – to serve as a cleaning house and collaboration space.
Expected audience	Those with an interest in the integration of emerging technologies to digital archiving 3D content and VR environments

Below is a Table representing supported operating systems to cater for various VR platforms.

Table 4: Representing VR Technologies and Learning

VR platform ^{a,b}	Content sharing ^c	Means of communication	World building support ^d	Accessibility	Supported operating systems	Supported VR headsets	Website
AltSpaceVR^e	Web content via browser ^f	Voice, text messages, emojis	Yes	Free	Microsoft Windows, Android	HTC ^g Vive, Oculus Rift, Oculus Go, Oculus Quest, Samsung Gear VR	Altvr.com
Engage^e	Whiteboard, images, videos, PDF, presentations	Voice	No	Free	Microsoft Windows, Android	All HTC, Oculus Rift, Oculus Rift S, Oculus Quest, Valve Index, Pico G2, Pico Neo 2	Engagevr.io
Rumii^e	Screen sharing, whiteboard, images, videos, PDF, 3D models	Voice, text messages	No	Free	Microsoft Windows, macOS, Android	HTC Vive, HTC Vive Pro, all Oculus	Dogheadsimulations.com/rumii
Mozilla Hubs^e	Screen sharing	Voice, text messages, emojis	Yes	Free, open source ^h	Any OS with browser support	Any headset with browser support	Hubs.mozilla.com
Glue	Images, videos, 3D models	Voice	Yes	Paid	Microsoft Windows, macOS, Android, iOS	HTC Vive, HTC Vive Pro, Valve Index, Oculus Rift, Oculus Rift S, Oculus Quest	Glue.work
Immersed	Screen sharing, whiteboard	Voice	No	Free version, paid features	Microsoft Windows, macOS, Ubuntu Linux	Oculus Go, Oculus Quest	Immersedvr.com
meetingRoom	Whiteboard, PDF	Voice	No	Free version, paid features	Microsoft Windows, macOS, Android, iOS	HTC Vive, HTC Vive Focus, all Oculus, all Pico	Meetingroom.io
Spatial	Web content via browser, screen sharing, 3D models	Voice	No	Free version, paid features	Microsoft Windows, Android	Oculus Quest, HoloLens	Spatial.io
Wonda VR	Screen sharing, images, videos, 3D models	Voice, text messages	Yes	Free version, paid features	Microsoft Windows, Android	HTC Headsets, Oculus Rift, Oculus Go, Oculus Quest, all Pico	Wondavr.com
vTime	Images	Voice, text messages	No	Free	Microsoft Windows, Android, iOS	Oculus Rift, Oculus Go, Google Cardboard, Google Daydream, Samsung Gear VR	Vtime.net
MeetinVR	Web content via browser, whiteboard, 3D models	Voice	No	Free	Microsoft Windows, Android	HTC Vive, Oculus Rift, Oculus Rift S, Oculus Quest	Meetinvr.net

Some general notes and comments:

1. The spatial platform automatically generates a custom avatar, using the students face;
2. VR platform is using streaming platforms, Facebook to stream and record classes;
3. Multimedia content is shared on a projection screen, by means of content sharing;
4. Own personal classrooms are easily customised using world building;
5. Educators in VR platform host events to prepare and support learners and educators;
6. Whiteboards, presentations, documents and videos is shared by sharing content; and open source software is a code designed for accessibility that

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Results

General Marks = 79

Total = 79