

# On Demand Mixed Reality (MR) Solutions for SEMI Equipment Manufacturing

A Landscape Analysis

ELPP Spring 2022

Final Report

Team 7

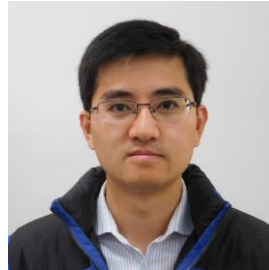
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# PRODUCT MANUFACTURING IN SEMI EQUIPMENT COMPANY

Semiconductor Equipment Manufacturing Business is one of the most Challenging fields in the Technology Sector today. Building a Semiconductor Chip is an extremely complex and expensive process and involves hundreds of manufacturing steps done in large and complex machines. The Global Market for Semiconductor Equipment manufactured by SEMI Equipment Companies is expected to expand beyond \$114 billion by 2022 [1]. The Foundry, Logic and Memory Fab Sectors account for almost the entire equipment Business sales and is expected to surge due to increasing investments in the Equipment businesses.

## Businesses

The major players in the SEMI Equipment Manufacturing Business are Applied Materials, ASML Holding NV, Lam Research, ASML, Tokyo Electron and KLA. Together the 5 major players constitute about 62% [Figure 1] of the SEMI Equipment Manufacturing Business in 2020 [2]. In 2021, the annual revenue figures of the 5 largest SEMI Equipment manufacturing companies are: Applied Materials \$23.06 Billion [3], ASML Holding NV \$20.16 Billion [4], Lam Research \$14.63 Billion (2021) [5], Tokyo Electron \$16.76 Billion [6] and KLA \$8.2B [7].

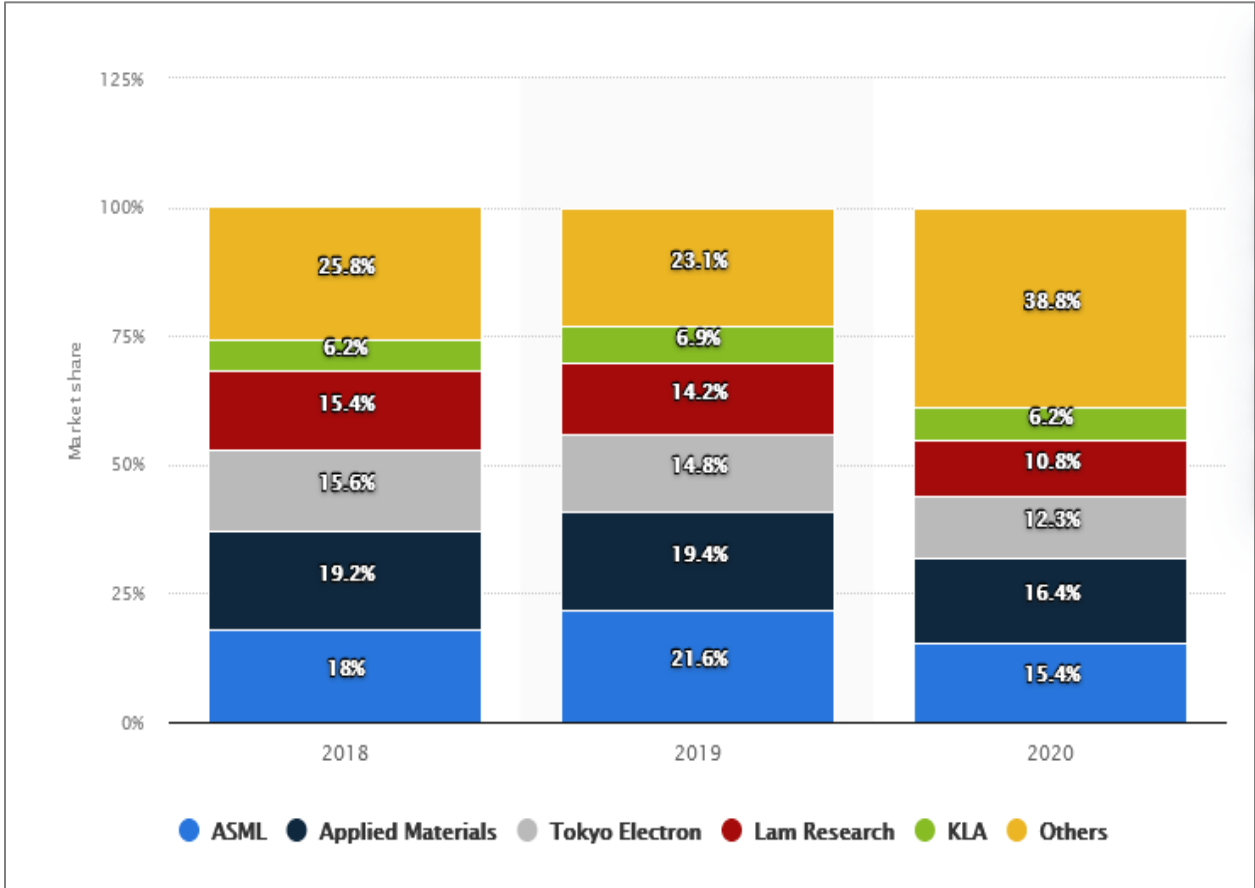


Figure 1: Semiconductor Equipment Market Share Worldwide, by Supplier (2018-2020) [2]

## Manufacturing Infrastructure

SEMI Equipment Manufacturing is Technology Heavy and as such requires extensive expertise in multiple areas. In order to support the burgeoning and challenging business of *SEMI Equipment Manufacturing*, the Companies have to maintain an extensive manufacturing infrastructure to support the following:

- A. Large Portfolio of Products
- B. Complex Hardware Technology
- C. Very Large Skilled Workforce
- D. Resources for maintaining a very high cost of Manufacturing.

The Manufacturing infrastructure in turn supports the SEMI Equipment employed by the Fab Equipment Sector Companies in Foundry, Memory and Logic [Figure 2]. In 2021, the breakdown of revenues in the above sectors are as follows:

- Foundry - \$53B
- Memory - \$52B
- Logic - \$12B



Figure 2: Product Manufacturing in SEMI Equipment Company

## CURRENT PROBLEMS IN SEMI EQUIPMENT MANUFACTURING

Due to the inherent complex nature of the SEMI Equipment, the design varies widely from Product to Product. As a result, the implementation of the manufacturing process across the Product portfolio is not a standard process. Multiple disciplines of Engineering, Physics, Chemistry, Software Engineering are involved in the manufacturing process. As a result, keeping the diverse workforce across the world trained

in the various aspects of manufacturing is a time-consuming process, leading to longer training time of Manufacturing Engineers. Any change in the product design can lead to a cascading change of manufacturing processes, which would be responsible for increased cycle-time in manufacturing. This leads to a lot of inefficiency in the manufacturing process, which leads to a longer time in production output [Figure 3]



Figure 3: Current Problem in SEMI Equipment Manufacturing

## Pain-points in Manufacturing

Manufacturing in SEMI Equipment Companies involve employees in manufacturing floor working together on several components of Large-scale machines with manufacturing documentation and technical product information in a precise step-by-step order, focusing on accuracy and throughput. A major challenge in this sequence of activities is that the process is not standardized, as several variations of the products are being assembled in a single facility. Employees often face workflow interruptions, as some components or products may be in the process of re-design due to rapid changes in Customers' requirements. This leads to delay in completion of manufacturing workflows, as manufacturing teams need to wait for Product Design Team to complete the new documentation. Moreover, interpreting hard-copy documents, blueprints, drawings to actual Large-scale products is often challenging to the employees in manufacturing floor, often leading to mistakes.

## Quality Assurance

Due to non-standard product designs and fast changing scene of Product designs, varying from product to product, sequence of complex manufacturing steps is in general., sometimes done with un-ergonomic devices and incomplete training methods. Manufacturing errors are often manually documented, in the absence of digital checklists, leading to miscommunication of defects or defects not getting corrected down the line in manufacturing. As a result, product safety issues can arise, coupled with quality issues in the final product, leading to customer dissatisfaction.

## Training

Due to product complexity, the training often involves going over lengthy documentation (procedures, manuals, checklists, safety steps), which can often get outdated due to rapid changes in product design or configuration. Moreover, the style of documentation is not suitable for on-demand access. The training

documentation is not delivered on smart devices, which current generation is more accustomed to. A more visual way of on-demand access to training documentation with actual overlay of the product will make the training process more relatable to the product.

## NEW MANUFACTURING TECHNOLOGY LANDSCAPE IN SEMI EQUIPMENT MANUFACTURING

We believe there is a new space for achieving higher levels efficiency in manufacturing in the SEMI Equipment Manufacturing Industry.

Our proposal is a new manufacturing technology landscape, which will incorporate a Platform with Mixed Reality (MR) Technology and On-Demand Content [Figure 4].

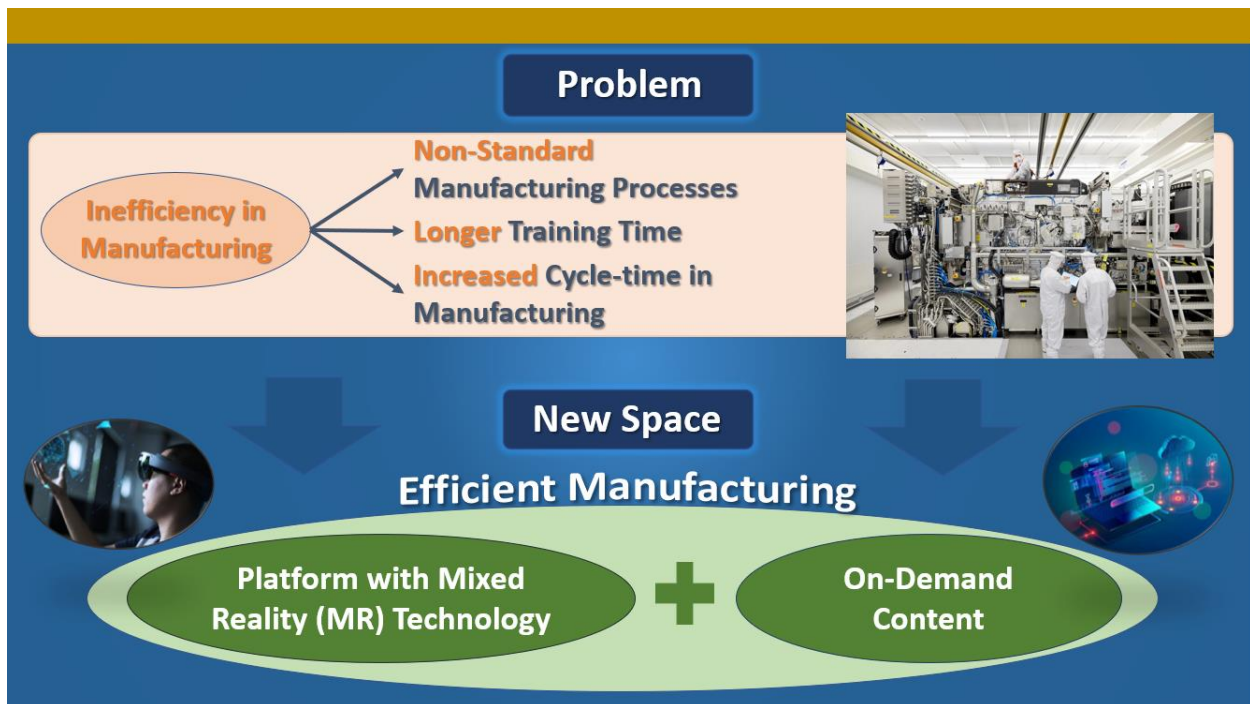


Figure 4: New Technology Space for Efficient Manufacturing

### What is XR/MR/AR/VR?

Extended Reality (XR) is an umbrella term encompassing Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) [Figure 5]. AR, MR, and VR exist along a spectrum between the physical and virtual world. On the physical end, AR is a composite of computer-generated images with the real world. On the digital end, VR is a fully immersive virtual experience, generating significant excitement recently as the Metaverse. In between these two extremes is the realm of MR. Along this spectrum, digital objects can interact with both the user and the real environment. Imagine a physical tool being used to manipulate a training hologram.

## What is XR/MR/AR/VR?

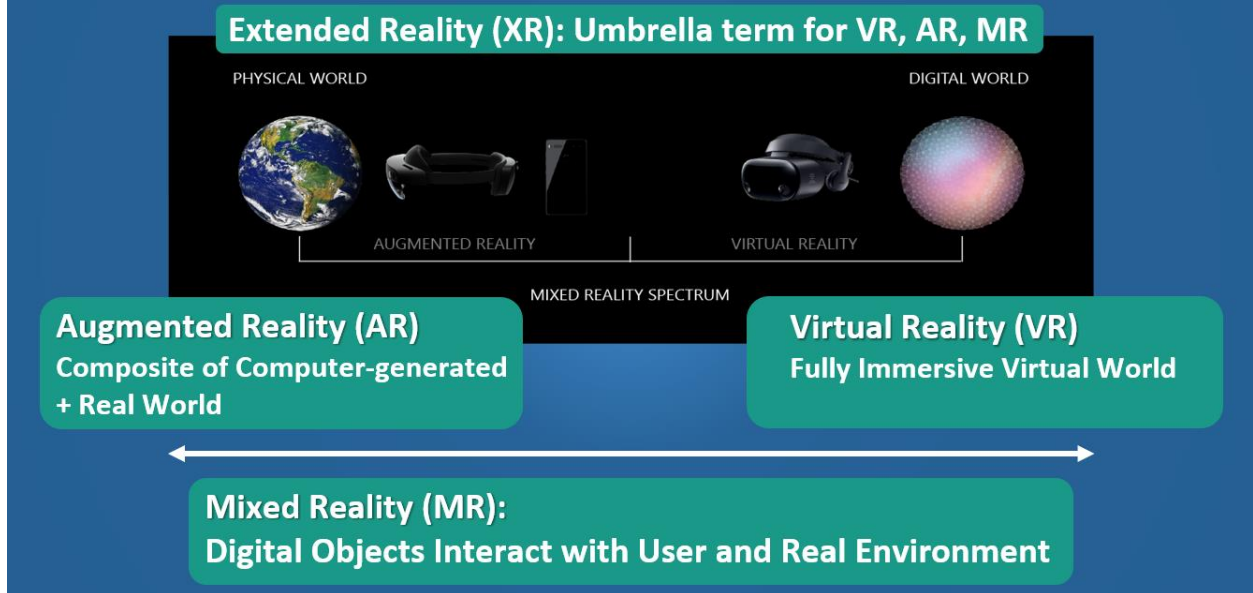


Figure 5: Definition of XR, MR, AR, VR

According to Artillery Intelligence, a research and analyst firm for business of spatial computing [8], the Global revenues for XR related hardware is expected to reach \$56B in 2022 end [Figure 6]. The total revenue in this sector comprises of AR + VR + Enterprise + Consumer Segments. Each Sector is then further sub-divided into Hardware, Software and Advertising. The largest sector is predicted to be Enterprise, which is expected to grow from \$671M in 2017 to \$28.5B in 2022 [Figure 7]. The adoption of XR Technology is dampened by Organizational Inertia, Enterprise Risk aversion and Sales Cycle. Hardware dominance is expected to be the first step in Enterprise Tech Adoption. Software will eventually gain adoption. In terms of prediction for adoption of XR technology, the following industries are expected to adopt the technology:

- Industrial
- Retail and Commerce
- Corporate and Finance
- Healthcare and Education

In this scenario, the XR devices and technologies Role in Operational Support, such as Manufacturing will determine the adoption.



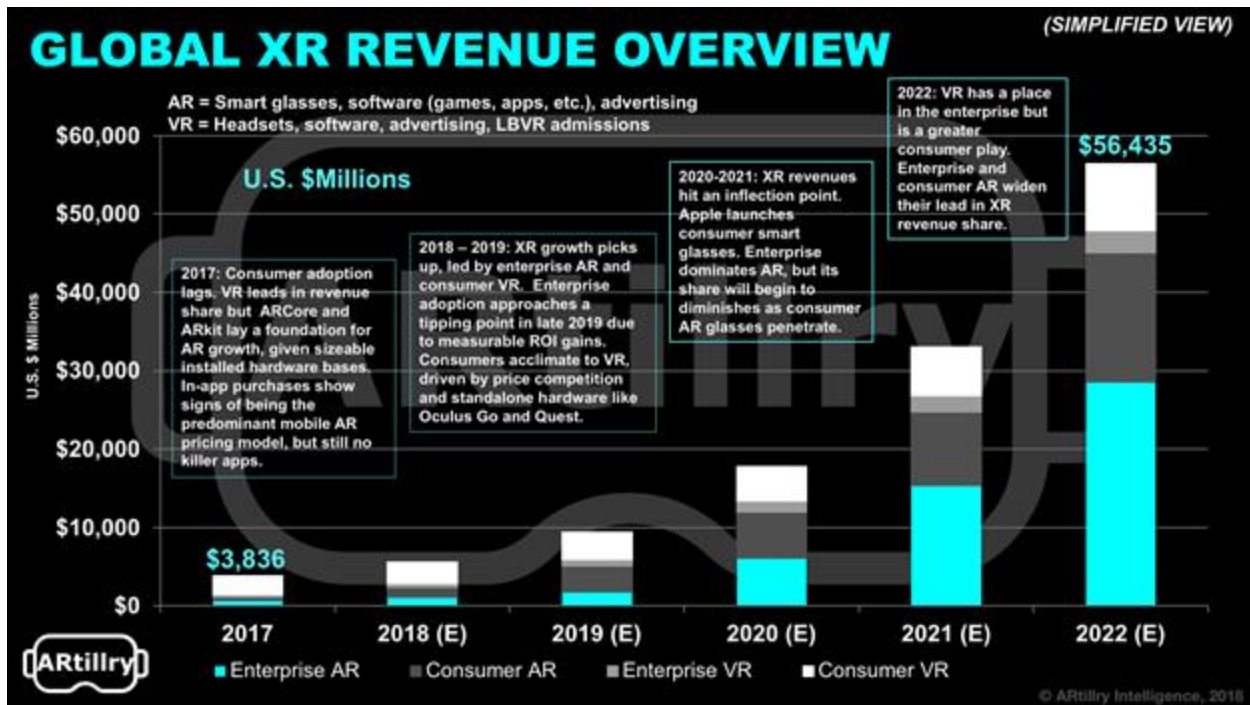


Figure 6: Global XR Revenue Projections [9]

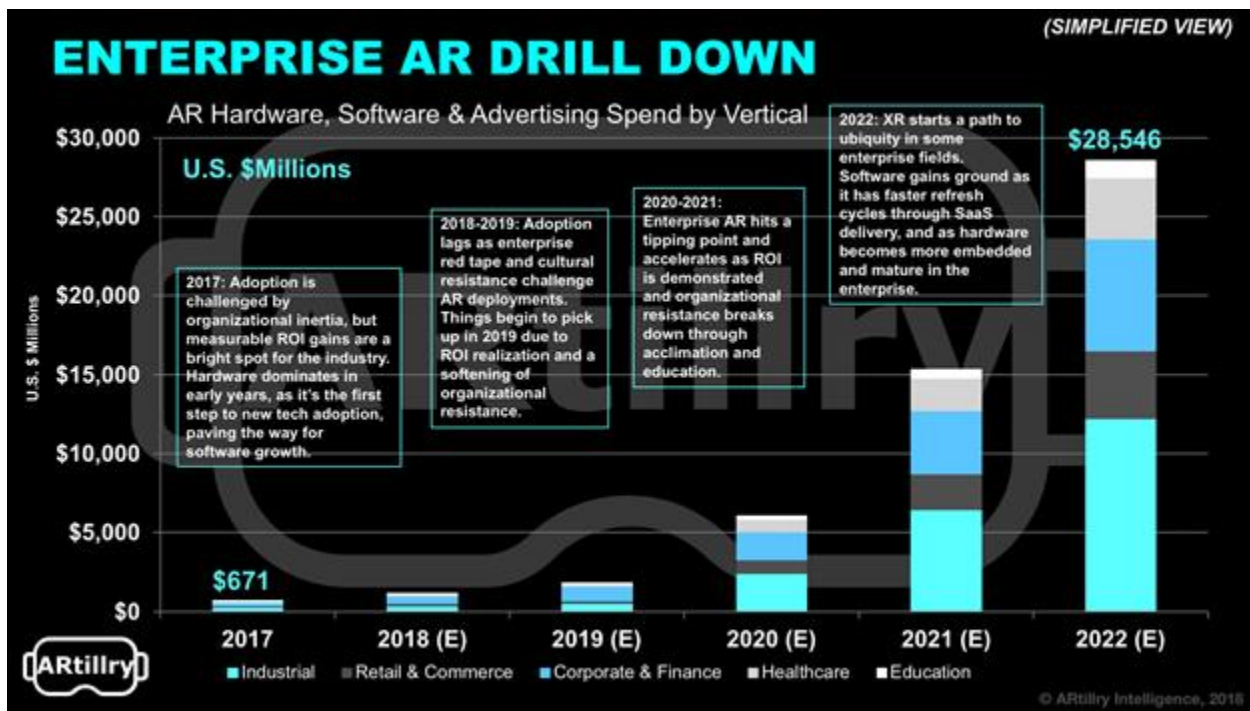


Figure 7: Global Spend on XR Categories [9]

# MR AND AR TECHNOLOGY SPACE

## Current Devices & Wearables

In the current landscape, there are quite a few companies dealing with MR and AR devices, and some of them have their own MR and AR Platforms.

The technology space for Mixed Reality has three major categories: The device or wearable [Figure 8], the platform for content delivery [Figure 9], and the opportunity for creation of the content [Figure 10]. The device/wearable and content delivery categories have multiple players ranging from established companies to startups.



Figure 8: Current MR, AR Technology Devices

The Device/Wearable market for Mixed Reality is dominated by the Microsoft HoloLens 2.

- Microsoft, a US multinational, is a publicly traded company with 2021 revenue of \$168 billion. The HoloLens 2 headset is a self-contained wearable that acts as a PC with in-situ processing and battery. It provides Augmented and/or Mixed Reality by integrating digital content such as 3D models, wiring schematics, and instruction sets on top of the physical objects. It can also allow the user to interact with these holographic items using real-world objects. The Microsoft HoloLens business models is B2B, not B2C, although headsets are available from the Microsoft store. Revenue comes from hardware sales, at \$3500/headset. Microsoft has contracts with Mercedes Benz and the US Army, and it is reported that additional corporations are using the Microsoft HoloLens for product support. The HoloLens works with Microsoft's Dynamic 365 remote assist platform and a number of other platforms, discussed later, created using open-source API for content delivery. The HoloLens 2 has a 52 degrees field of view. Although the HoloLens 2 is the

premier headset, opportunities for improvement include an even larger field of view. For reference, a standard Virtual Reality headset has a field of view of 110 degrees [10].

The Augmented Reality (AR) Headset space has a range of offerings.

- Realwear, a private company based in Vancouver, Washington, with later stage VC funding in Feb 2022 of \$20 million, sells wearable headsets which are marketed as the most rugged on the market. Realwear has multiple industry partners, including Lenovo, Autodesk, Zoom, Mercedes-Benz, etc. The flagship product is the Realwear Navigator 500. Realwear headsets are available on Amazon. The Realwear headset has a 20 degrees field of view [11].
- Vuzix is a publicly traded company with 2021 revenue of \$13.2 million. It has offices in Rochester, NY; Oxford, UK; and Tokyo, Japan. The Vuzix headset is used in healthcare, manufacturing, warehousing, and field service. It also has contracts with US military defense contractors. Vuzix headsets are available on Amazon. Vuzix devices have up to 28 degrees field of view [12].
- Epson, a Japanese multinational, is a publicly traded company with 2021 revenue of \$8.998 billion. The Epson Moverio Augmented Reality Smart Glasses are used for Remote Service and Support, Collaboration & Training. They are also marketed for personal entertainment and tourism. The flagship Epson Moverio BT-35E has a 23 degrees field of view while the Moverio BT-40s has a 34 degrees field of view [13].
- Magic Leap, a private company based in Plantation, Florida, with later stage VC funding in October 2021 of \$500 million, sells Augmented Reality headsets designed for manufacturing, health, and defense industries. The flagship product, Magic Leap 2, is schedule for release in 2022 pending regulatory approval, and will have a 70 degrees field of view. Magic Leap 1, their older product, has a field of view of 50 degrees. Magic Leap sells their units direct or through a limited network of distributors [14].

## Current MR and AR Platforms

The platform space is also crowded [Figure 9]. For Mixed Reality, specifically with offerings for the Microsoft HoloLens 2:

- Microsoft Dynamics 365 Remote Assist is Microsoft's own platform for Mixed Reality. Microsoft Dynamics 365 Guides may be used to create step-by-step holographic instructions. Microsoft Dynamics 365 Remote Assist allows live remote assistance from anywhere, and works on the Microsoft HoloLens 2 as well as any Android or iOS device. The various capability: Guides, Remote Assist, and Field Service, are each available as subscription services [15].
- Arvizio is a private company based in Ottawa, Canada. Arvizio products include Immerse 3D, which provides AR/MR capability for sharing 3D models on various headsets and allows the sharing of materials without the development of customer application software. AR Instructor is a framework for providing step-by-step augmented reality instructions [16].

- TeamViewer is a publicly traded company based in Germany. It focuses on cloud-based technologies to enable online remote support and collaboration globally. Teamviewer launched in 2005. It had 2021 revenue of 501.1 million euro. Non-commercial users of TeamViewer Assist AR may use the software for free. For commercial use, the company uses a subscription model. TeamViewer has partnerships with Philips and Siemens for remote maintenance of digital displays and information sensors [17].
- Buildwagon, based in Montreal, Canada, provides web based mixed reality development for Microsoft HoloLens. They provide a subscription service with increasing cost per month based on available storage and features [18].
- Adobe, a multinational corporation with 2020 revenue of \$12.87 billion, has created the Adobe Aero product. This augmented reality authoring tool allows for designers to create immersive experiences through the Adobe tools they already know how to use without having to know how to code. It is primarily aimed at personal and artistic use [19].



Figure 9: Current MR, AR Technology Platforms

In the space of platform and content delivery for AR,

- ScopeAR, a private company based in San Francisco, California, received later stage VC funding of \$7.3 million in November 2021. ScopeAR's product is the Worklink platform for remote assistance and the creation of AR content directly from existing CAD and work instruction files. Key partnerships include Microsoft and ServiceMax. Worklink offers a subscription service with

multiple tiers of service. The products are targeted for general training, also Aerospace and Defense, Medical Devices and Life Science, and Advanced Manufacturing [20].

- Vsight, a startup venture based in Lithuania, received \$50k seed investment in October 2019 and €775k seed funding in November 2021. Vsight-Remote is an Augmented Reality remote assistance software package that allows experts to connect directly with field technicians and customers through AR smart glasses for real-time collaboration and file sharing. It is compatible with RealWear, Vuzix, and Epson smart glasses and available as Android and iOS App. Vsight is offered as an annual subscription model with 3 Tiers of pricing from basic model to plans with support for more users and larger file sharing. Target industries for Vsight include Automotive, Machining, Mining, Oil and Gas, and Construction [21].
- KitAR, a startup venture based in London, UK, offers Kit-Build: an AR step-by-step instruction editor, Kit-smart, a product to automatically perform quality checks in manufacturing processes, and Kit-insight, a product to trace and track workers processes and compare them to the plan for continues improvement of operations [22].

## **White Space – New MR-based Landscape for Efficiency in SEMI Equipment Manufacturing**

Current XR Technology landscape players are focused on devices and providing a generic platform which can interface with a variety of devices. The devices are currently ready to be used in various scenarios, however, they face challenges for targeted industries like, SEMI Equipment Manufacturing, as customized content is currently non-existent and means to deliver the content On-demand to the MR/AR devices is also not developed.

The open opportunity, or white space, in this industry, is the area of content creation and deliver the customized content real-time to the point-of-use [Figure 10].

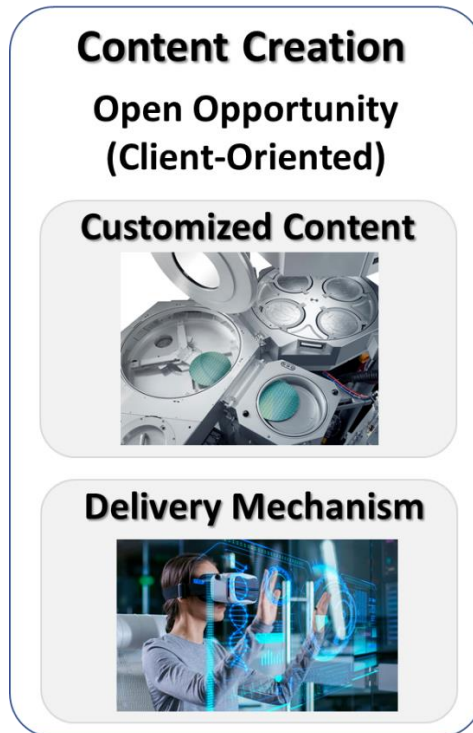


Figure 10: Future Technology Landscape of Client-Oriented Content Creation

## CURRENT INDUSTRIAL APPLICATIONS OF MR TECHNOLOGY

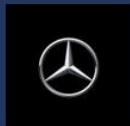
For MR devices, current industry applications are limited to automotive and healthcare sectors [Figure 11]. Mercedes Benz has deployed HoloLens2 solutions combined with Dynamics 365 for service applications. Through fast access to wiring schematics and documentation, service personnel can troubleshoot issues more efficiently, increasing the service turn-around time and customer satisfaction [23].

Toyota Corporation has also employed similar methods towards faster inspection of painted surfaces reducing the operation time from days to hours [24].

In the healthcare sector, GE has employed MR technology to accelerate training of ultrasound sonologists by overlaying 3D content on top of mannequins [25].

# Industry Applications

## Automotive



Microsoft Hololens 2 +  
Dynamics 365



*Fast access to wiring-schematics for diagnostics & repair*  
(Source: techspot.com)



Microsoft Hololens 2 +  
Azure + Dynamics 365



*Operators inspect the painted surface*  
(Source: iot-automotive.news)

## Healthcare



Microsoft Hololens 2

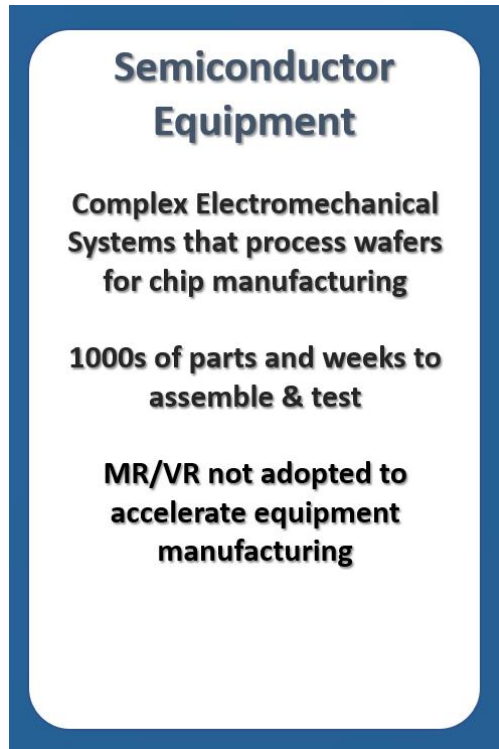


*Training ultrasound sonologists –Virtual organs  
overlaid on top of the mannequin*  
(Source: ge.com)

Figure 11: Current Industrial Applications of MR Technology

## HOW MR TECHNOLOGY CAN BE INTEGRATED IN SEMI EQUIPMENT MANUFACTURING

MR/VR adoption in semiconductor manufacturing has lagged in comparison. Semiconductor equipment includes complex electromechanical systems that process wafers for chip manufacturing. With thousands of parts to assemble methodically and with quality, the build-test process typically takes multiple weeks. A significant opportunity exists in this sector [Figure 12].



**Figure 12: White Space in SEMI Industry Application of MR Technology**

A combination of a suite of integrated products of MR Technology devices and platform with Client-customized Content can be sweet spot for addressing the Manufacturing problems of SEMI Equipment industry.

### **Use Case of MR Technology Platform**

A typical Semiconductor Manufacturing Equipment is very complex with thousands of Electro-Mechanical Parts working in unison with System Software. Manufacturing the equipment requires a plethora of documentation, created by Teams across the various locations of the Equipment Manufacturing Company. We believe, the complex process of manufacturing can significantly benefit with the usage of MR Technology Platform and customized content required for manufacturing.

A uniqueness of the proposed Landscape is the customized manufacturing documentation that can be easily deployed across the different manufacturing locations of the Equipment Company. The deployment aspect would be taken care of by the Platform, which would interface with the MR devices that the Equipment Company would like to deploy across its Manufacturing sites. The deployment can be done through a Cloud-based Platform, which can provide World-wide Access to the Product and Manufacturing related documentation, with on-demand access from the MR devices [Figure 13].

This whole cycle of on-demand and instant access of Client Curated Content will make available “Standardized” Manufacturing Content across many locations, and will reduce training time significantly. The Manufacturing locations and the employees will have the unique benefit of cross-linking the specific Manufacturing issue with documentation, 3D models and step-by-step instructions.



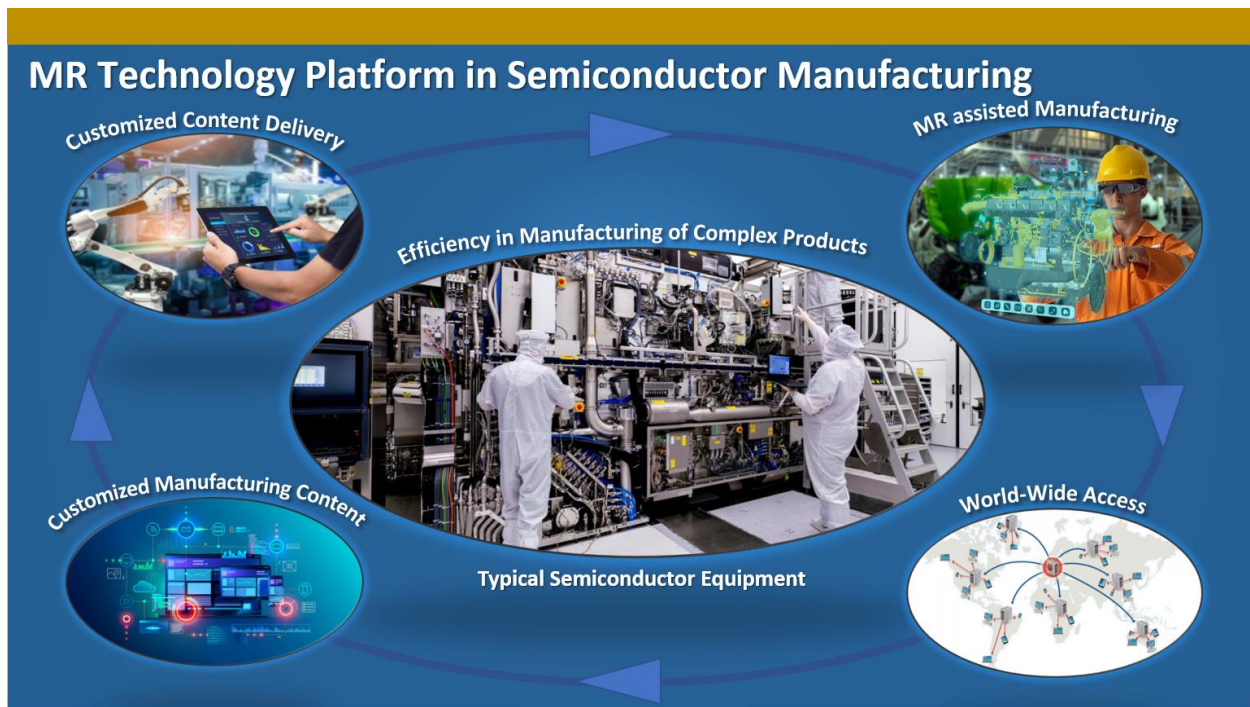


Figure 13: MR Usage Case in SEMI Equipment Manufacturing

## Benefits of MR Technology

At least 20% reduction in build-test cycle time is expected if MR/VR is adopted alongside robust hardware and content. This cycle time reduction is expected from a combination of instant access to build-test documentation including 3D models and drawings, faster equipment troubleshooting/rework for reduced downtime and faster training of manufacturing personnel through MR-recorded sessions.

With the above cycle time reduction, the number of build launches per week and associated factory capacity would increase resulting in an estimated \$50M/yr additional revenue for an NPI factory and \$200M/yr additional revenue for a High-Volume Factory. The cost of deployment is estimated to range between \$0.7M/yr to \$1.4M/yr for an NPI and high-volume factory respectively. The cost of deployment is expected to be a small fraction of the benefit resulting in a high return on investment. However, the realization of the benefit is strongly dependent on robust content customized for building the complex hardware assemblies [Figure 14 and Figure 15].

## Opportunity in Semi Equipment Manufacturing

### Instant access to customized content

Assembly/Test documentation, 3D models & drawings

Faster equipment rework, troubleshooting & diagnostics

Faster training of personnel

**20%**

faster build-test cycles

### Benefit

**\$50 - \$200 M/yr**

increased revenue per factory



Cycle  
time



Factory  
capacity



Launches /  
wk

### Cost

**\$0.7 - \$1.4 M/yr**

Cost per factory

**Equipment/Platform License**

Highly customized content for building complex HW is key for value proposition

High ROI- very fast payback

Figure 14: MR Business Opportunity in SEMI Equipment Manufacturing

## ROI Calculation

### ROI Calculation Model

	NPI factory	HVM factory
<b>Benefit</b>		
Launches/week	5	20
Increased launches with 20% takt time improvement	1	4
Increase in annual shipments	52	208
Increase in revenue (\$ M)	52	208
<b>Cost</b>		
Fixed Cost per MR/AR equipment (\$K)	3.5	3.5
Fixed Cost for equipment for all personnel (\$K)	350	700
Enterprise yearly per-license cost (\$K)	3.5	3.5
Total yearly license cost (\$K)	350	700
Total yearly cost (\$ M)	0.7	1.4

Figure 15: ROI of MR Usage n SEMI Equipment Manufacturing

## WHY SEMI MARKET IS NOT YET PENETRATED BY MR TECHNOLOGY?

Manufacturing organizations are currently utilizing Mixed Reality devices mostly for task Guides & task management solutions, with Design & Prototyping trailing closely. Usage of Mixed Reality for Remote Assistance is lowest but projected to grow in the next year.

Implementation issues like integration and deployment prevent current users from adding new solutions to their portfolios. For prospective users who are in the consideration stage, budget, timing, and lack of knowledge are the largest barriers to adoption.

Over half of all manufacturing organizations expect a return of 30% or more on average from their investment in Mixed Reality across Task Guides & Task Management, Design & Prototyping, and Remote Assistance solutions.

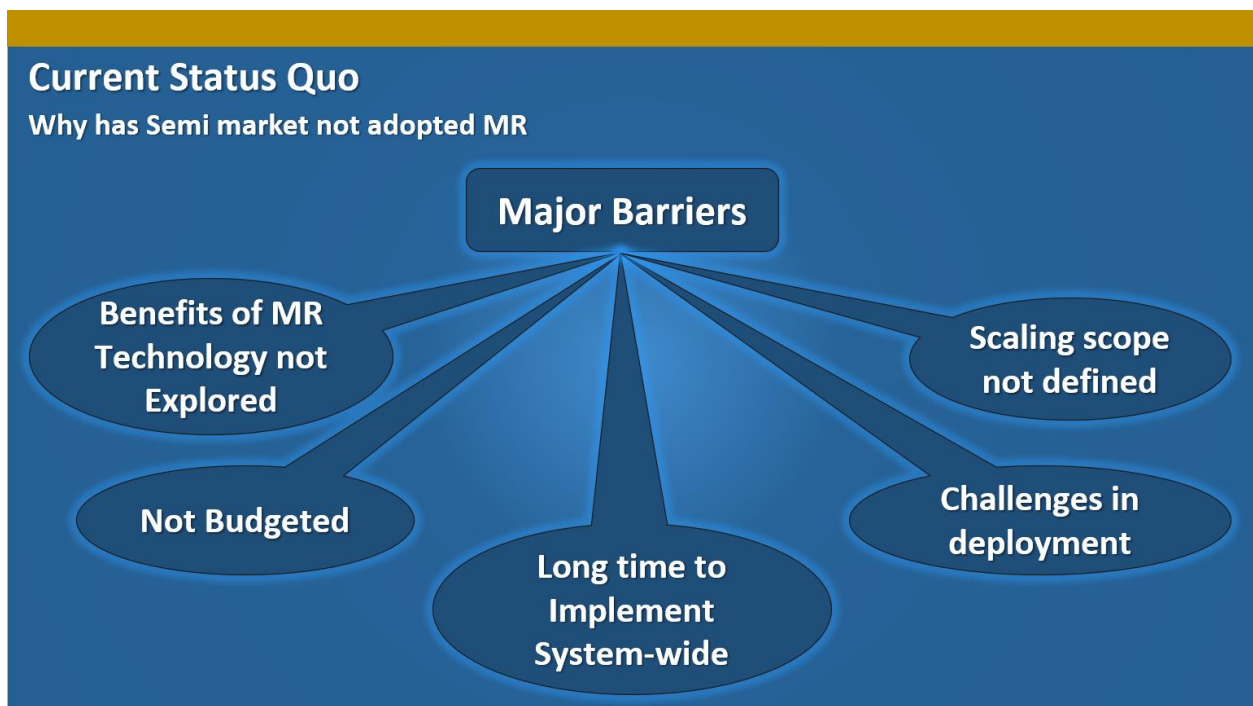


Figure 16: Current Status Quo of SEMI Manufacturing

There is no MR adoption in Semi Equipment Manufacturers yet due to the similar barriers, and unique challenges arising from the specific domains [Figure 16]:

- *Benefits of MR Technology Not Explored:* Equipment Companies do not have enough expertise to know what it takes it to make it successful. For example, whether the current MR application development is good for creating effective Semi equipment manufacture Task Guides & Task Management solutions.
- *MR Technology Implementation not Budgeted:* Since majority of current Manufacturing operations are still following the traditional route, the exploration of MR Technology is not part of annual budget and needs ROI model to convince executives to invest.

- *Long Implementation Time*: Takes too long to implement: Time for implementing may not meet the product development schedule.
- *Challenges in Deployment*: Don't have enough deployment training: Training may not be enough for being effective and efficient.
- *Scaling Scope Not Defined*: Unsure about scalability in organization: Even with success of POC, change management in a whole organization is a different challenge.

## **MR TECHNOLOGY PLATFORM – GO-TO MARKET STRATEGY FOR SEMI EQUIPMENT MANUFACTURING**

We envision, that the implementation of MR Technology Platform along with development of customized content delivery architecture for efficient manufacturing needs to be done in phases. Initial phases would be for development of the content focused on specific aspects of manufacturing, tie it up with specific MR hardware optimized for consuming on-demand content to aid in manufacturing. Eventually, the entire ecosystem can be monetized by delivering services to the Clients per their specific needs [Figure 17].

Three large goals are naturally defined in individual phase, and each phase has the achievement/product delivered to market.

- Phase 1: Content creation
  - Customized documentation
  - Training 3D models
  - Assembly documentation
- Phase 2: Hardware and Service, create Content and Hardware Ecosystem, which are compatible with each other for seamless content consumption by on-demand customer.
- Phase 3: Platform will be built in 3<sup>rd</sup> phase, and will provide customized service based on user demand. And business model will be transitioned to subscription base.
- Each phase will be verified and validated based on the setting goal/target.
- Target customers: TIER 1 SEMI manufacturing companies
  - Applied Materials
  - LAM Research
  - ASML
  - TEL
  - KLA
- The feedback and user experience will be collected in 1<sup>st</sup> two phases, and will help to build up platform in 3<sup>rd</sup> phase which can provide the customized service.

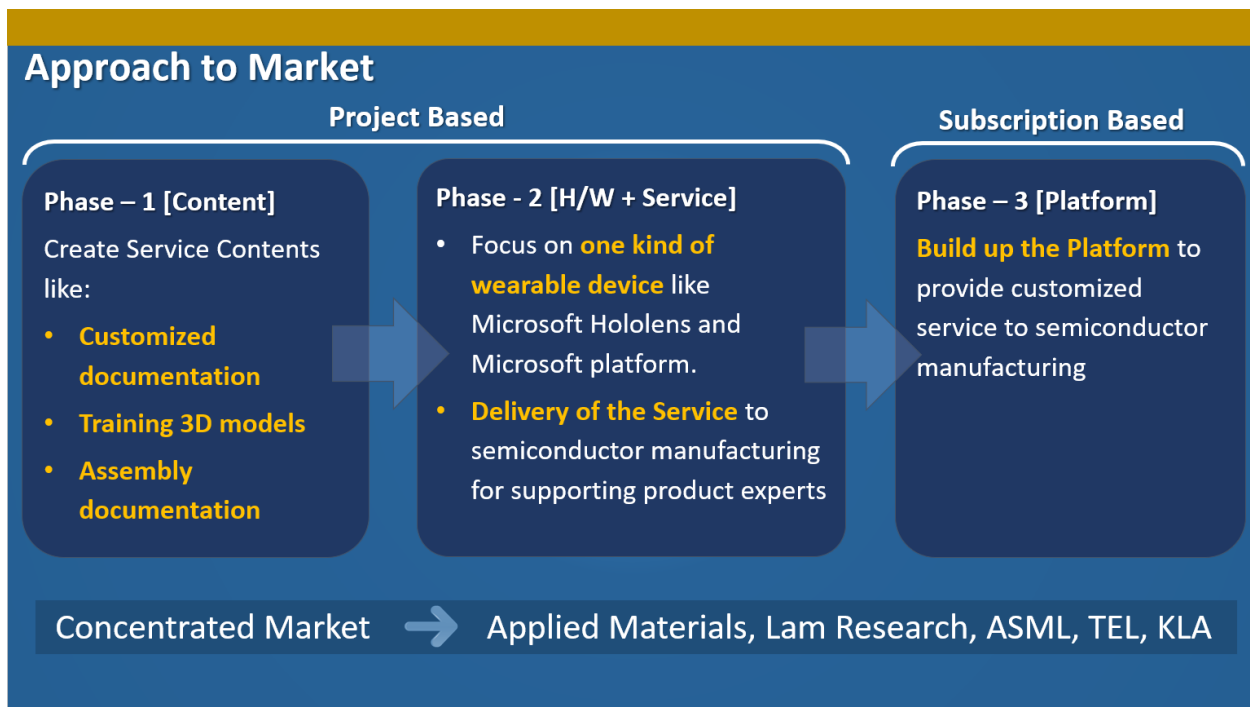


Figure 17: Go-To Market Strategy of MR Technology Platform in SEMI Equipment Manufacturing

## SUMMARY

We believe that the implementation of MR Technology Platform with its in-built Custom-Content delivery mechanism can have significant benefits to the SEMI Equipment Manufacturing Companies [Figure 18]. Customized Manufacturing Content per specific Hardware is one of the unique aspects of Value Proposition in this Landscape. It has the potential to have a high Return on Investment (ROI) and very fast payback to the SEMI Equipment Manufacturing Companies, if the means of delivery of the customized Content is efficiently managed through the MR Technology Platform to the respective devices being used by the end-users of the Technology.

Due to instant access to standardized Manufacturing Documentation, there will be improvement in manufacturing efficiency, lead time reduction and across-the-board improvement in training efficiency.

Due to increased throughput in manufacturing, around \$50-\$200 M/Year increased revenue can be realized per manufacturing location, based on an estimated 20% reduction in Manufacturing Cycle Time.

The increased efficiency will lead to more Production facility Capacity, resulting in Product launches/week.

Implementation of MR Technology Platform for Content Delivery has a lower entry barrier, as regards Implementation Costs are concerned. It is estimated to be \$0.7-1.4M per Manufacturing location, which will include MR/AR devices and Yearly License cost for Enterprise Software.

## Summary

- Semiconductor industry will benefit from **increased Manufacturing Efficiency**
  - **Instant access** to build & test documentation, wiring schematics and 3D models, quick data entry
  - **Faster training** of personnel
  - **Faster equipment rework & troubleshooting**: Creation of recorded sessions & quality tracking
- **Benefit**: Estimated \$50 - \$200 M/yr **increased revenue per factory**
  - Based on 20% reduction in cycle time -> **More factory capacity** -> **More launches / week**
- **Cost**: Estimated \$0.7 - \$1.4 M per factory, **Lower Entry Barrier**
  - AR/MR Hardware for **equipping all personnel**
  - **Yearly license** for enterprise/platform

Content <-> HW customization is key for value proposition  
High ROI- very fast payback but cycle time savings can be realized only if the content is customized for instant and efficient access

Figure 18: Summary of MR Technology Implementation in SEMI Equipment Manufacturing

## NEXT STEPS

In order to execute new ventures in the proposed technology landscape, we believe the following major milestones need to be satisfied [Figure 19]:

- (A) Form Focus Teams
- (B) Partner with SEMI Equipment Manufacturers
- (C) Obtain funding and get on-board with Venture Capitalists

Focus Teams need to include experts from SEMI Equipment Manufacturing Companies, who can provide necessary feedback on the specific pain points and desired solutions. The feedback on manufacturing pain points can then be utilized to interface with MR technology experts and App/software development experts to plan for customized content creation architecture and delivery systems

Partnership with SEMI Equipment Manufacturers is key, since initial feedback on effectiveness of hardware and software can be obtained by piloting at targeted sites, like Applied Materials, Lam Research etc.

Getting funding from VCs to kickstart the development of content creation and platform is super critical. Access to VCs will also lead to getting access to a network of experts, who can advise on making the ventures more attractive to the client companies, like SEMI Equipment Manufacturing Companies.

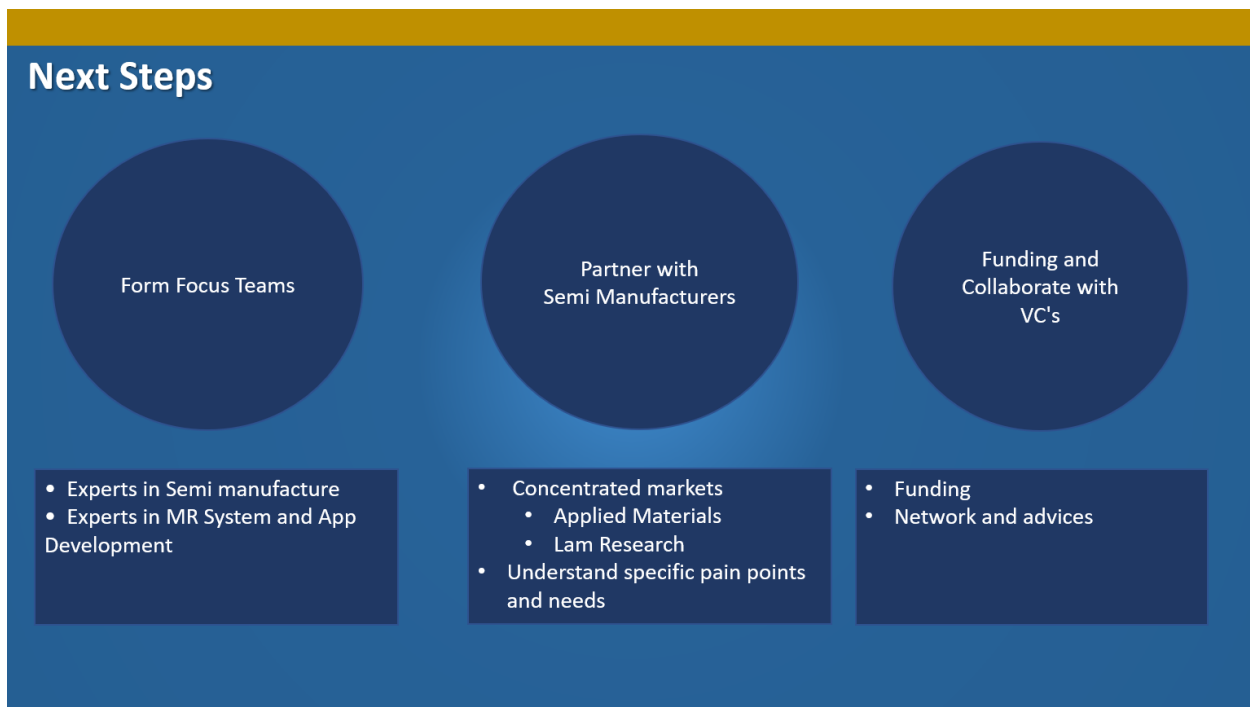


Figure 19: Next Steps for Implementation of MR Platform in SEMI Manufacturing

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