

Annex A-2: Immersive Media & Advanced Interfaces

1 Brief Introduction

Annex A-2: Immersive Media & Advanced Interfaces (IMAI) – highlights the advancements and recent megatrends associated with IMAI and to imagine how we will interact with IMAI related emerging technologies. These emerging technologies provide newer avenues to users to interface with information and enable both consumers and enterprises to be able to experience highly intuitive interactions. IMAI can be defined as the technologies that impact the 5 human senses of **Vision (sight), Tactile (touch), Auditory (hearing), Olfaction (smell), and Gustation (taste)**.

Market Study

Global & Regional Trends

The aforementioned five IMAI technologies are expected to experience continuous growth in the 2017 to 2022 forecasted period. Among these IMAI technologies, Vision technology will have the greatest market potential and growth, with forecasted global market spending of ~US\$209 billion in 2022 (which accounts for over 85% of total identified IMAI market) and a compounded annual growth rate (CAGR) of 71.6% from 2017 to 2022. The United States will hold the leading position in AR/VR market, driven by many US-based technology leaders such as Facebook, Apple, and Google actively investing in the mobile AR market. The Asia Pacific region (excluding Japan) is expected to account for ~30% of total AR/VR market in 2022 (~US\$62.5 billion), experiencing a rapid growth rate of 68.5% from 2017 to 2022. Within the APAC region, China is estimated to hold over 90% share of the total APAC (excluding Japan) AR/VR market in 2018 (~US\$11 billion), driven by strong investments by leading technology companies. For AR/VR market, there are several key sectors such as Infocomm and Media (including videogames, live event, and video entertainments), healthcare, real estate, retail, education, engineering, and military. Among them, AR/VR videogames are one of the high potential sector with projected 2017 to 2022 CAGR of 90.9% and 54.7% respectively. Other global IMAI technologies are expected to reach the market size of ~US\$20 billion for Tactile, ~US\$18 billion for Auditory, and ~US\$1 billion for Olfaction.

Singaporean Trends

In Singapore, IMAI technologies are estimated to be valued at US\$685 million by 2022. Likewise, vision technology (AR/VR technology) will account for the majority of the IMAI market and hence, Infocomm and Media sector is expected to have the largest potential with the market share of over 45%. Healthcare and construction sectors show the second and third largest demand respectively, followed by real estate and retail sectors. Singapore can develop itself as a hub for IMAI technologies by developing strong capabilities and ability to market products globally.

2 Technology Study

Contributions of IMAI Technologies to Cloud Native Architecture

As a part of the overall technology roadmap recommendation, Singapore needs to establish a Cloud Native Architecture to improve access to emerging technologies amongst the stakeholders and assure Services 4.0. We believe IMAI technologies will play an important part in executing the Cloud Native Architecture as highlighted by the exhibit below. *Exhibit 1*, below shows how IMAI technologies will contribute to the development of the Cloud Native Architecture.

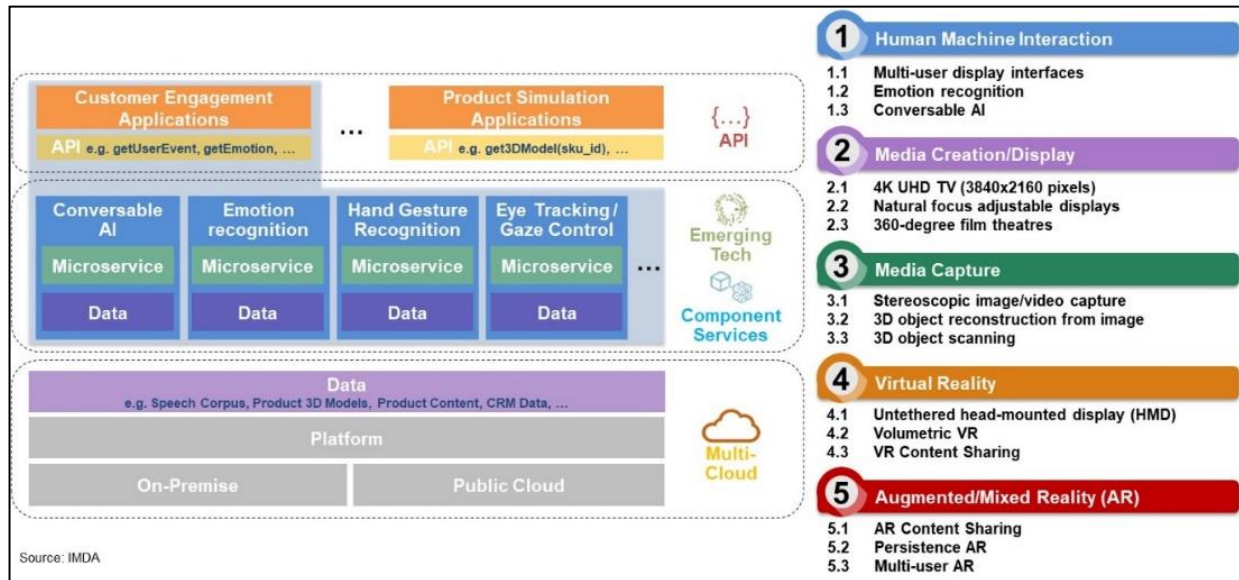


Exhibit 1: Contribution of IMAI technologies to Cloud Native Architecture

3 SWOT Analysis

Our study of the Singaporean landscape and the global market for IMAI technologies reveals specific strengths, weaknesses, opportunities and threats as discussed in the exhibit below.

STRENGTHS	WEAKNESSES
<ol style="list-style-type: none"> 1. Presence of international IMAI players (tech & media giants) in Singapore 2. Strong innovation hubs (e.g. IMDA's PIXEL) and global reputation of local research institutes & universities 3. Active R&D efforts by research institutes & universities, IHLs and local corporate labs in the IMAI space (e.g. Fraunhofer, CUTE, LiveLabs, ARTC, etc.) 4. Strong communication infrastructure such as mobile and network connectivity (e.g. piloting of 5G) 5. Government willingness to support promising local companies 6. Strong regulatory & legal framework (e.g. IP protection laws) 	<ol style="list-style-type: none"> 1. Small domestic market and lack of scale 2. Low risk-appetite amongst enterprises to invest in new technologies like IMAI 3. Lack of talents for R&D and tech development 4. Core IMAI technologies dominated by international players – lack of local tech developers 5. Inconsistent level of IMAI adoption and digital capabilities amongst local enterprises (e.g. local tech providers need to upskill; local solution providers lack expertise / knowledge to quickly adopt IMAI tech)
OPPORTUNITIES	THREATS
<ol style="list-style-type: none"> 1. Existing Smart Nation initiative to be leveraged – make Singapore as a hub for experimental & innovative use of technology 2. Strong export market opportunities leveraging high growth potential in APAC 3. Strongly service-oriented country – sectors with high potential to adopt IMAI tech such as retail, healthcare 	<ol style="list-style-type: none"> 1. Need for Singapore to constantly keep abreast with fast moving tech advancement, in order to fully realise market opportunities from IMAI R&D projects 2. Increasing competition in the region due to their lower cost (e.g. Thailand, Philippines), increasing competitiveness (e.g. Malaysia's EFTZ) and large investments and capital (e.g. China, Korea)

Exhibit 2: SWOT for IMAI technologies

IMAI technologies require a focused set of strategies, with Singapore's unique strengths and weaknesses in mind. These recommendations need to enable development of local technology capabilities and drive adoption of IMAI technologies amongst industries, in order to tap onto the strong regional growth potential. As a highly service-oriented country, Singapore already has active R&D efforts demonstrated by innovation hubs and local research institutes, aiming to meet increasing demands from global and local IMAI players. Furthermore, existing initiatives such as Smart Nation initiative could be leveraged to make Singapore as a hub for emerging technologies, encouraging collaborative efforts across the region. Singapore also need to continue providing a favourable environment with government support, necessary regulatory and legal framework, which ultimately can help Singapore to lead the fast-moving tech advancement.

4 Recommendations

1. Singapore should establish 'IMAI Micro-Services Platform' in order to democratise the access to IMAI technologies. It can be achieved by adopting a Cloud Native Architecture approach, which offers the potential to improve ease of use, provide more flexibility, ensure scalability and reduce cost. It can further integrate and harmonise the disparate development processes of experience enablers amongst the various local enterprises.
2. Singapore should build 'IMAI Translation Engineering Centre' for local SME technology providers who may not have the dedicated product engineering resources, hence, increasing opportunities to actualise potential R&D work done by RIs and IHLs into commercial products. This centre will be designed to have a nation / industry-wide impact and establish an effective IP framework to facilitate easier co-sharing IP between the collaborators. This centre could also explore cross-country collaborations / partnerships with other similar centres / hubs.
3. In addition to 'IMAI Translation Engineering Centre', 'Research Productisation Workshops' such as roadshows and engagement sessions should be organised for local technology providers to be connected and in sync with RIs and IHLs. This will further enhance the collaborative efforts between local technology providers and RIs and IHLs to direct their R&D efforts in areas with greater commercial and practical potential

4. Singapore should continue to prioritise investments in 'IMAI Technologies' which drive Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) applications e.g. Computer Vision and Human-Machine Interaction. This is to leverage on the current global and regional growth potential in sectors utilising IMAI (e.g. Retail, Logistics, Build Environment, Media Entertainment) and a continuous study is recommended to assess the evolving market demands and re-evaluate optimal technologies to invest in.
5. Singapore should also invest in related 'Supporting Technologies', in particular communications technologies such as 4k/8k displays and 5G mobile networks, to enable Singapore to lead the proliferation of IMAI technologies.