



OPPORTUNITIES FOR MILITARY M&S TO CAPITALISE ON GAMING TECHNOLOGIES AND COMPETENCES

MSG-184- NATO Modelling & Simulation Group (NMSG) Symposium
21/22 October 2021

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OUTLINE

1. Study Introduction
2. Gaming Ecosystems
3. A Defence M&S Ecosystem
4. “Heatmapping”
5. Targeted Investigations
6. Conclusions

MOTIVATION AND CONTEXT

What?

- 1) This study reviewed the full breadth of the gaming ecosystem to seek out opportunities for defence M&S in the short and longer term
- 2) It was targeted at opportunities which might lead to a “step change” in training and education in defence, including influencing the future direction of Modelling and Simulation as a Service (MSaaS)
- 3) The 20-day study ran from late November 20 to end March 21.

Why?

- 1) *The Video Games Ecosystem is valued at \$175bn and serves 2.8bn gamers across the world*
- 2) *It is growing, dynamic, and highly competitive*
- 3) *It is culturally important and influential*
- 4) *It drives many of the hardware and software technologies that underpin military S&T*
- 5) *Exploited directly by the military since at least 1996 (US Marine Doom)*

50 YEARS OF GAMING HISTORY, BY REVENUE STREAM (1970-2020)- NOVEMBER 23, 2020

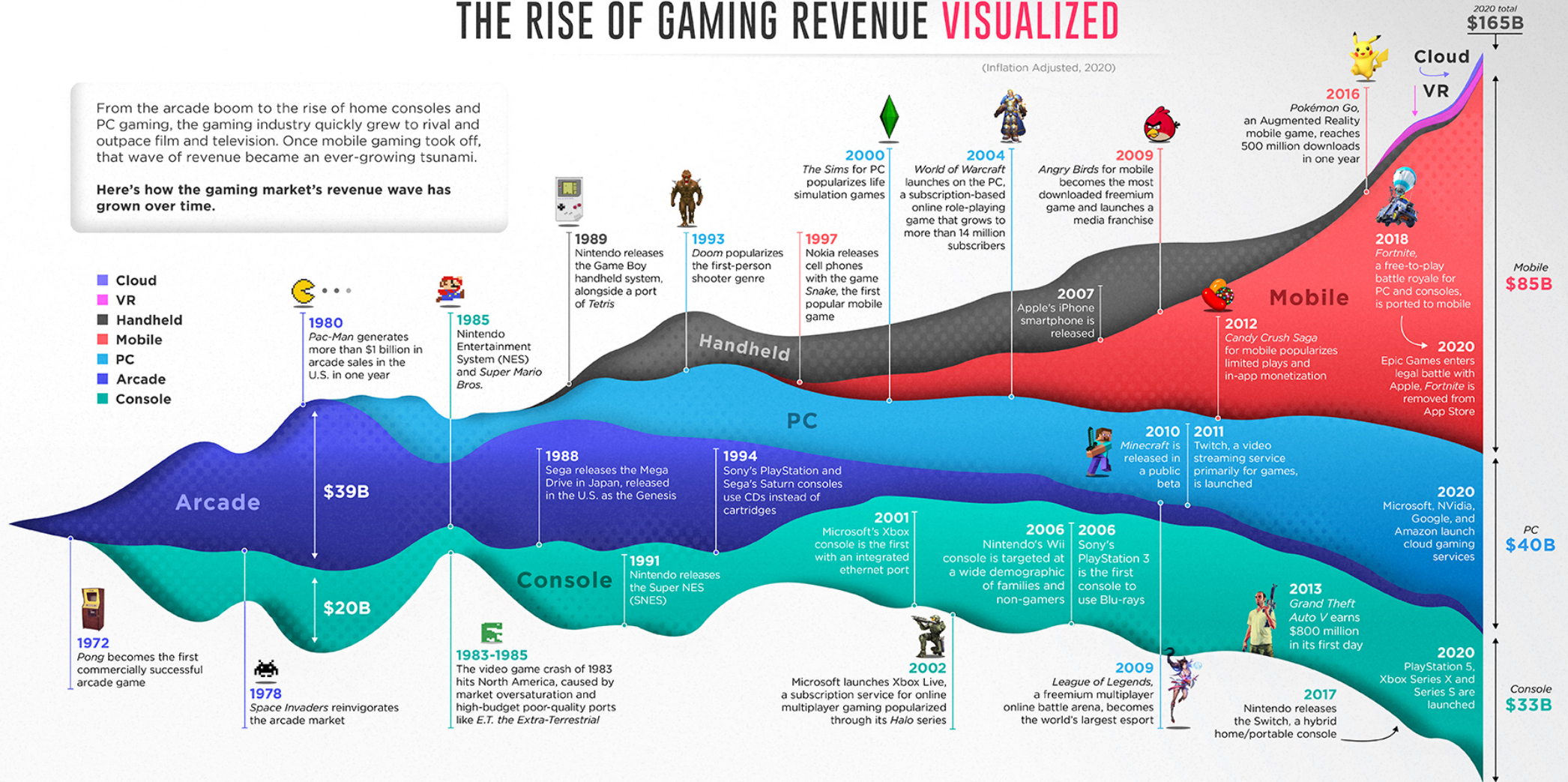
THE RISE OF GAMING REVENUE VISUALIZED

(Inflation Adjusted, 2020)

From the arcade boom to the rise of home consoles and PC gaming, the gaming industry quickly grew to rival and outpace film and television. Once mobile gaming took off, that wave of revenue became an ever-growing tsunami.

Here's how the gaming market's revenue wave has grown over time.

- Cloud
- VR
- Handheld
- Mobile
- PC
- Arcade
- Console



SOURCE Pelham Smithers
COLLABORATORS RESEARCH + WRITING Omri Wallach | DESIGN + ART DIRECTION Clayton Wadsworth



Facebook, YouTube, Twitter, Instagram, LinkedIn icons and handles: /visualcapitalist, @visualcap, visualcapitalist.com

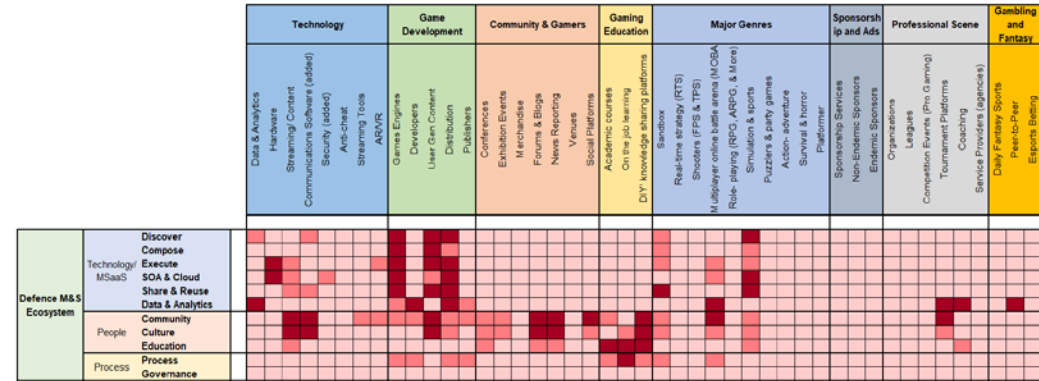
THE STUDY

Work Packages

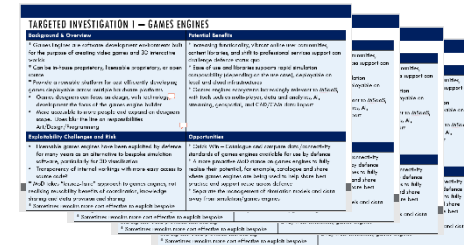


Breadth of Scope

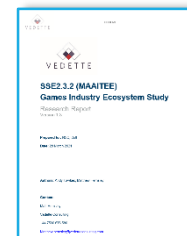
Outputs



Heatmap of Gaming Ecosystem vs Defence M&S Technology, People and Process (circa 400 Gaming Ecosystem elements considered)



- Games Engines
- Cloud Gaming
- Data and Analytics
- Community

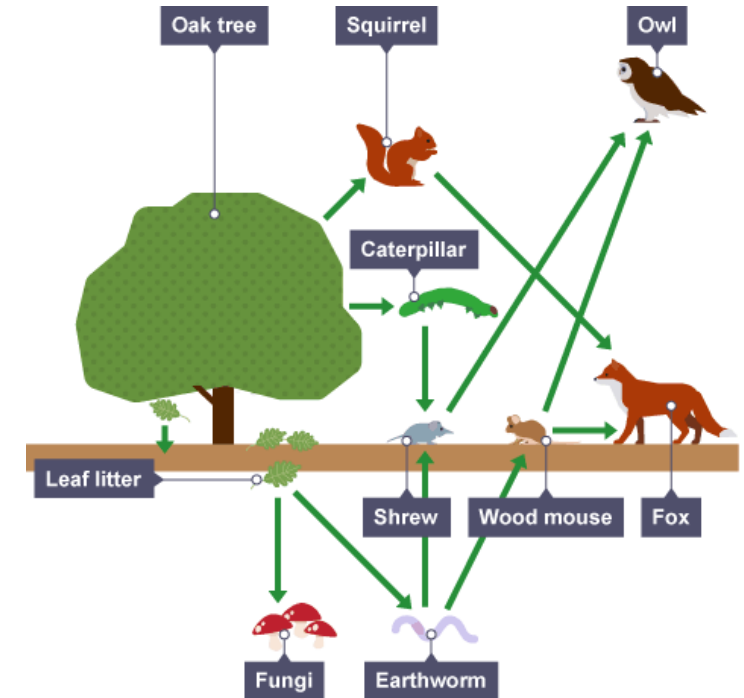


20 Quick Wins and Longer Term Opportunities

GAMING ECOSYSTEMS

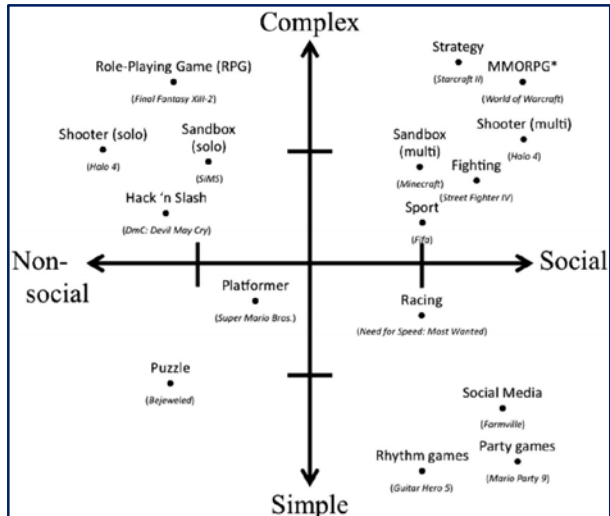
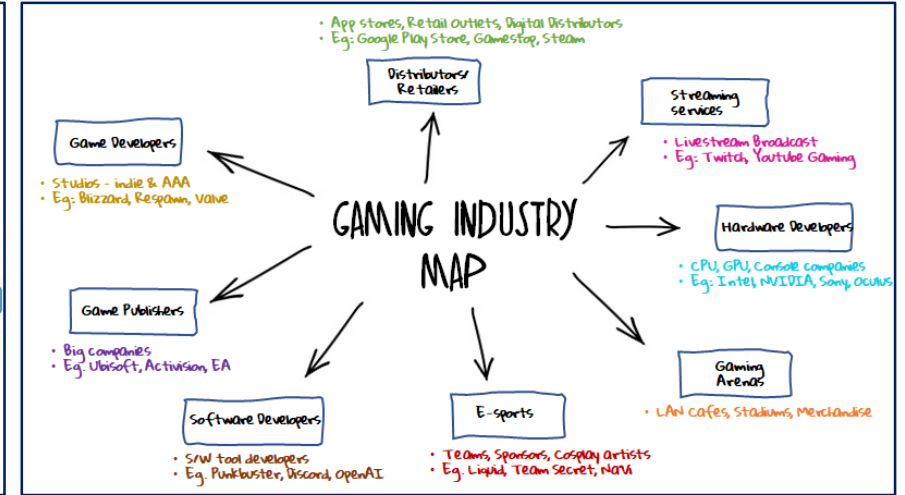
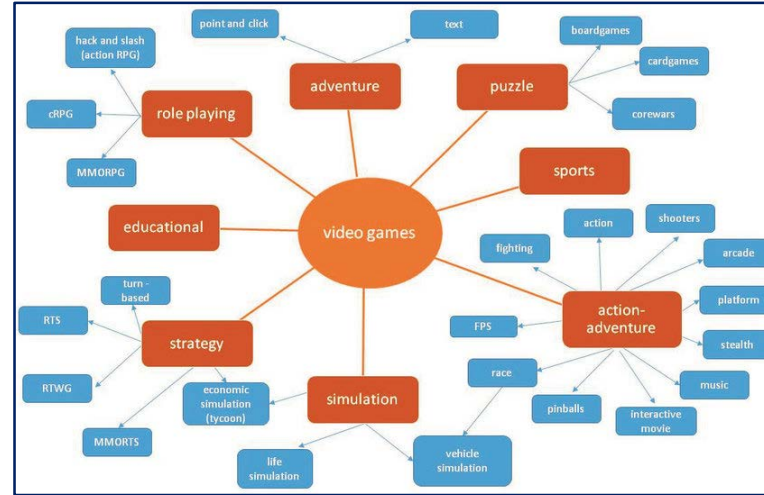
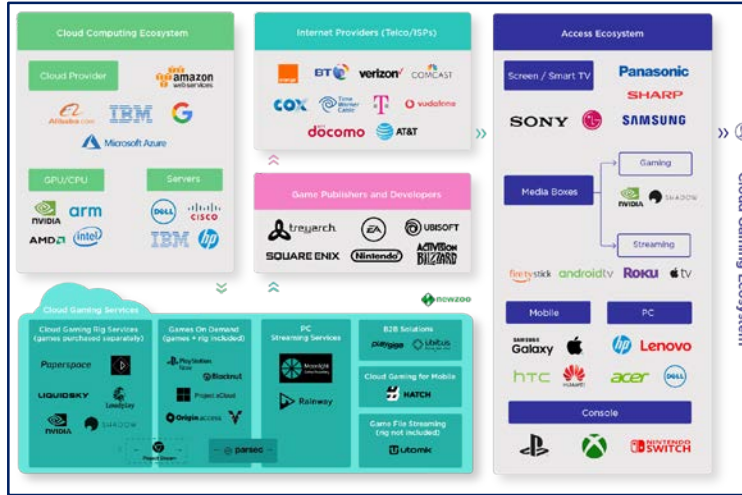
WHAT IS AN ECOSYSTEM?

1. Natural ecosystem - Sharing resources, creating resources for one another, competing for resources, co-evolving, and constantly adapting (Tansley 1935)
2. Business ecosystem - An economic community supported by a foundation of interacting organizations and individuals - the organisms of the business (Moore 1993)
3. Digital ecosystem - A distributed, adaptive, open socio-technical system with properties of self-organisation, scalability and sustainability inspired from natural ecosystems (2002)
4. Mutual reliance, Transfers of value, Self organisation



GAMING ECOSYSTEM(S) ARE LARGE, COMPLEX AND EVOLVING AND DEPEND ON THE 'VIEWPOINT'

ECOSYSTEM MAPPING EXAMPLES



KONVOY VENTURES – SEP 2020

INVESTORS “IN THE INFRASTRUCTURE TECHNOLOGY, TOOLS, & PLATFORMS OF TOMORROW’S VIDEO GAMING INDUSTRY”



“X-AXIS” – GAMING ECOSYSTEM (KONVOY VENTURES (+))

Technology	Game development	Community	Sponsorship & Advertisers
Hardware Data and Analytics Engagement Tools Streaming Content AR/VR Internet Infrastructure Backend Services Education User Acquisition	Game Engines Anti-Cheat User Generated Content Distribution Developers Publishers	Conferences Exhibition Events Merchandise Communications and Forums News reporting Venues	Sponsorship Services Non-endemic sponsors Endemic sponsors
Major Games	Professional Scene	Gambling and Fantasy	Gaming Education
Apex Legends Call of Duty Minecraft Fortnite etc	Organisations Leagues/Organisers Competition Events Tournament platforms Coaching Talent Agencies	Daily Fantasy Sports Peer-to-Peer Esports betting	<i>Universities</i> <i>Online</i> <i>On the Job</i>

A DEFENCE M&S ECOSYSTEM

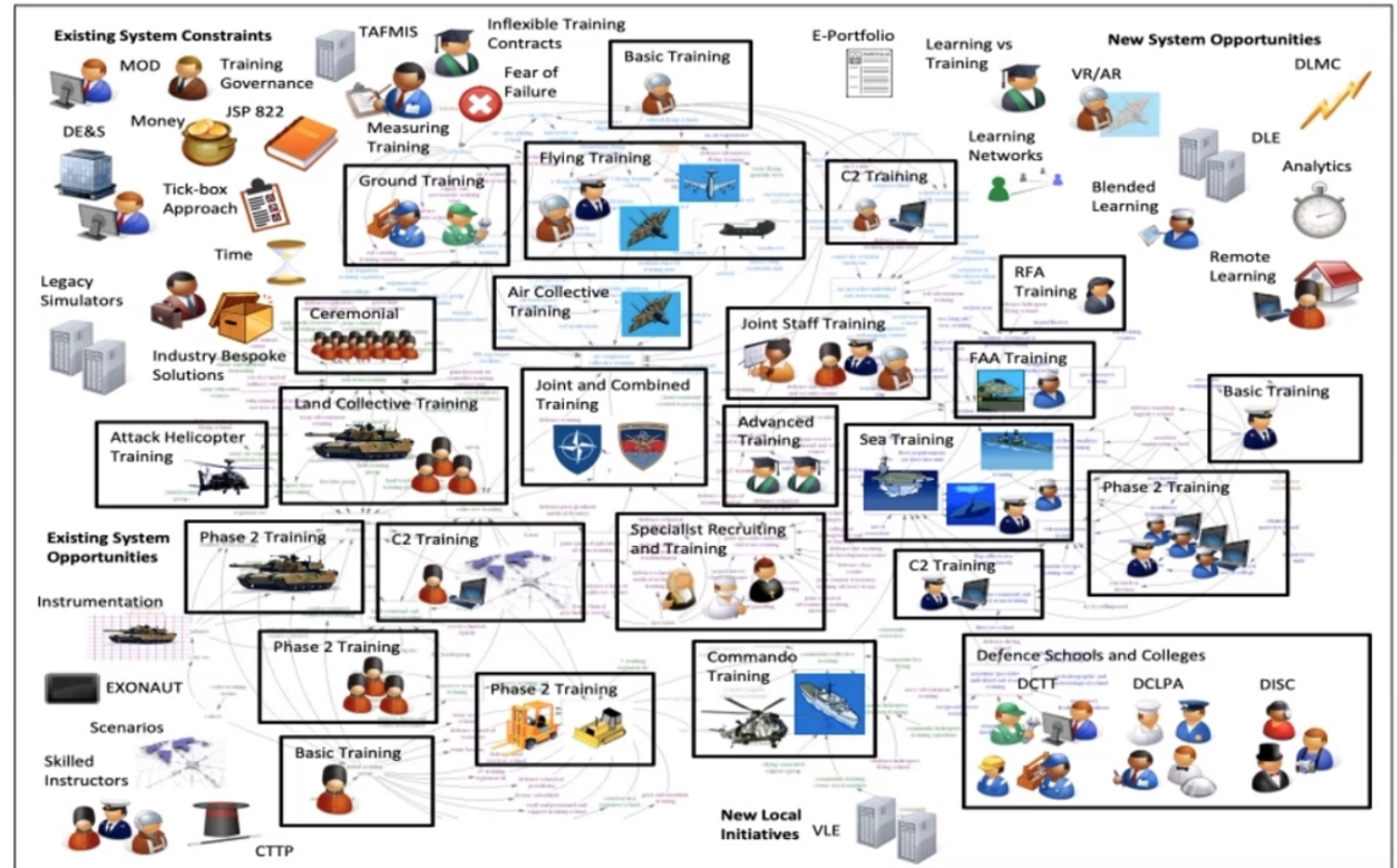
A FUTURE VISION FOR THE DEFENCE LEARNING ECOSYSTEM

A Future Vision for the Defence Learning Ecosystem (vIIITSEC)

Speakers

Abby Laishley, Cognitive Psychologist at the Defence Science and Technology Laboratory (Dstl)

Megan Pleva, Business Development Executive, LiMETOOLS Ltd












A FUTURE VISION FOR THE DEFENCE LEARNING ECOSYSTEM

“Technology in itself will not be exploited unless the operational, cultural, financial, contractual and organisation aspects are also considered”



MORE THAN TECHNOLOGY (NATO)

<p>Key Partners </p> <ul style="list-style-type: none"> • Industry (simulation products and technology) • NATO M&S developer and agencies • Nations, M&S centers • Academia • Standardization bodies • Infrastructure providers • System integrator • Data suppliers (systems data, terrain ...) 	<p>Key Activities </p> <ul style="list-style-type: none"> • To collect requirements • To provide a user-friendly front end • To provide M&S services for each customer segments • To assess M&S and enabling tools • To provide an operating environment • To provide consulting an technical services • To provide pricing framework • To specify hardware and software <p>Key Resources </p> <ul style="list-style-type: none"> • Cloud-based computing • Connectivity • Subject Matter Experts • Champions • Access to operational systems • Font-End portal • MSaaS OS, tools and doc. • IP and licenses • Models, data, simulation • Funding • Crypto 	<p>Value Proposition </p> <ul style="list-style-type: none"> • Agility • Accessibility • Usability • Affordability • Security • Sustainability 	<p>Customer Relationships </p> <ul style="list-style-type: none"> • Self service and Automated services • Communities (cf. segments) • Q&A • Business relations managers • User groups <p>Channels </p> <ul style="list-style-type: none"> • Internet and Intranet • Email • Social media / Forum • Advertising • Newsletters • Webex • Meetings and conferences • Articles 	<p>Customer Segments </p> <ul style="list-style-type: none"> • Operations (operational planning, analysis, decision-making) • Capability development (defense planning, concept development & experimentation) • Mission rehearsal • Training and education (exercise) • Procurement
<p>Cost Structure </p> <ul style="list-style-type: none"> • Multi-level security • Services, models, data and simulations (to include licensing) • IT Infrastructure and facilities • Subject matter experts (modellers, simulators, IT, security, commercial, procurement ect.) 		<p>Revenue Streams </p> <ul style="list-style-type: none"> • NATO • Nations • Industry • Contributed services 		

MSaaS Business Model (MSG-168)

“Y-AXIS” – DEFENCE M&S ECOSYSTEM

1. Technology
2. People
3. Process

“Y-AXIS” – DEFENCE M&S ECOSYSTEM

	Defence M&S Attribute	Note
Technology	Discover	Discover M&S services (MSaaS)
	Compose	Compose M&S Services (MSaaS)
	Execute	Execute M&S Services (MSaaS)
	Cloud & Online Services	Infrastructure to enable MSaaS
	Share & Reuse	Ease of M&S sharing and reuse across defence
	Data & Analytics	Improved insights from training
People	Community	Capabilities to bring people together
	Culture	Willingness to share and reuse
	Education	Ability to exploit M&S effectively
Process	Process	Cost effective M&S development and usage
	Governance	Strategy, policies and co-ordination

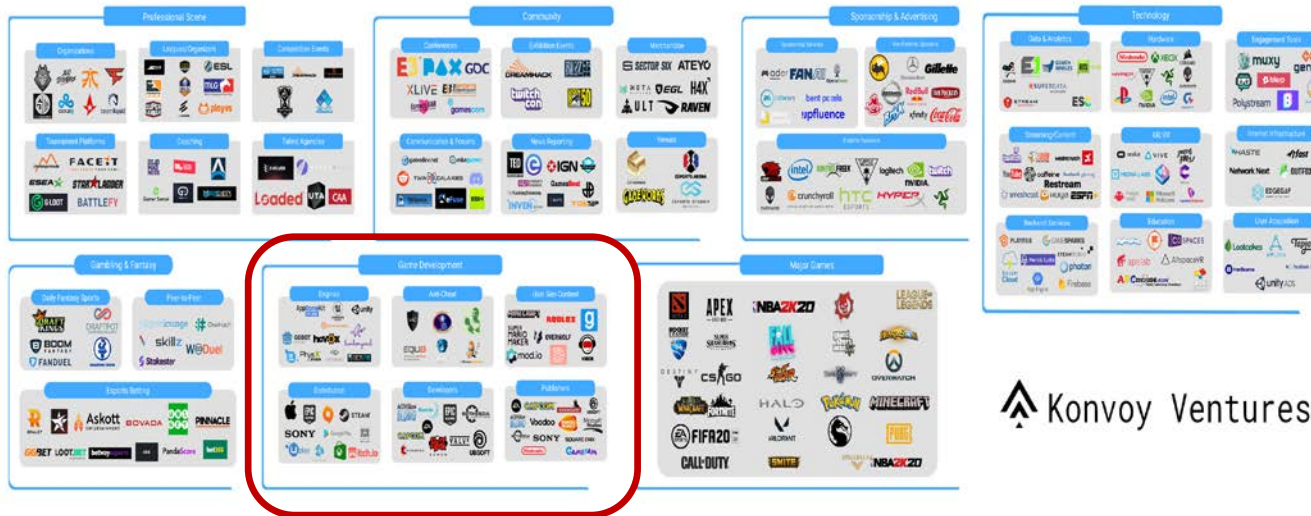
“HEATMAPPING”

CHALLENGE RECAP

1. X-Axis – Gaming Ecosystem
 - a) Choose an up-to-date ecosystem with depth and breadth
 - b) Some companies not included in Konvoy ecosystem (e.g. Discord, Tencent) and others had failed or been purchased
2. Y-Axis – Defence M&S Ecosystem
 - a) Define a Defence M&S Ecosystem
3. 495 companies/data points considered in varying levels of detail
4. Looking for “Nuggets”
5. Captured in Excel Spreadsheet

HEATMAP ANALYSIS

Example



Category:	Game Development				
Sub-categories:	Games Engines	Games development	User Generated Content	Distribution	Publishers
Elements:	Unity Unreal Engine CryEngine Amazon Lumberyard AppGameKit Frostbite GameMaker Nvidia GameWorks Solar 2D (formerly Corona) Havok Buildbox Cocos2Dx GODOT Cocos2d Etc.	Capcom Activision Blizzard Valve EA Games Ubisoft Epic Games Nintendo Riot Games Bluehole/Krafton Bethesda Softworks Respawn Tencent Etc.	Minecraft Dota 2 Roblox StarCraft Garry's Mod Super Mario Maker Super Smash Bros Brawl Counter-Strike: Global Offensive Hiberworld Etc.	Epic Games Store Apple EA Games Origin Valve Steam Nintendo eShop Google Play Sony PlayStation Store Xbox Games Store Microsoft Store Blizzard Battle.net Ubisoft Connect gog.com Etc.	Capcom EA Games Kongregate Activision Blizzard SEGA Bandai Namco Ubisoft Nintendo Sony Square Enix Xbox Game Studios Bethesda

3	Technology/concept worthy of investigation now
2	Relevant but mature/exploited Commercial Off The Shelf (COTS) concept
1	Not currently relevant

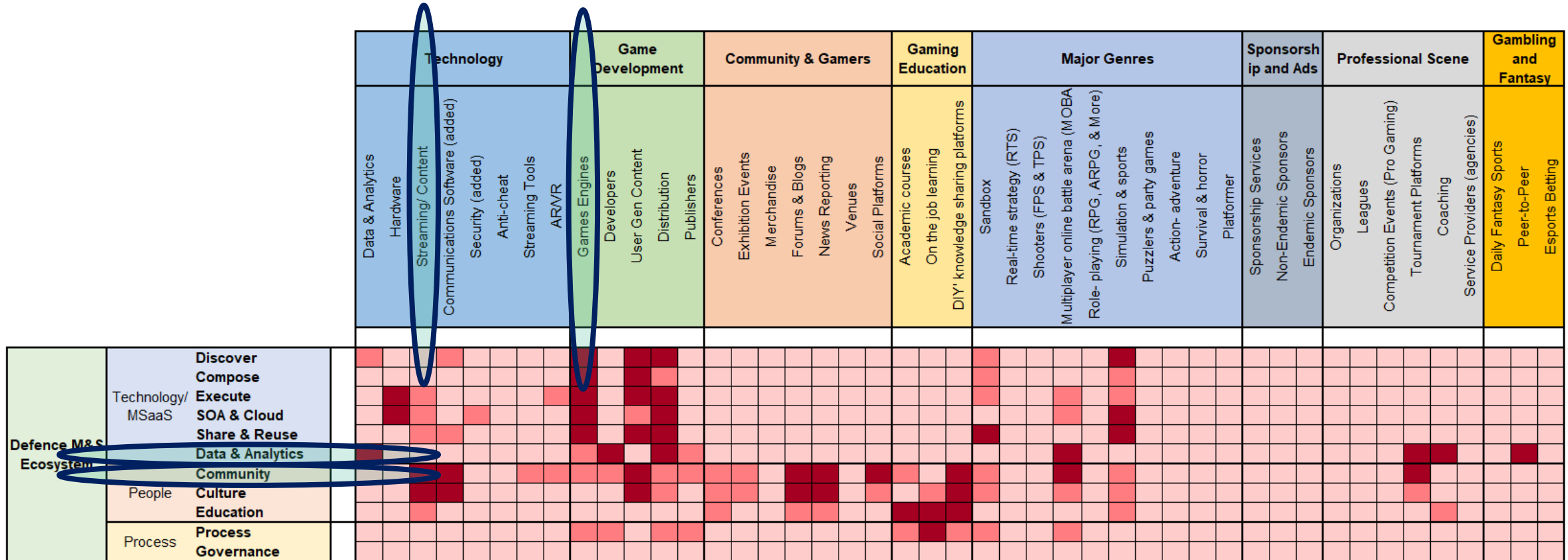
STUDY HEATMAP

		Technology	Game Development	Community & Gamers	Gaming Education	Major Genres	Sponsorship and Ads	Professional Scene	Gambling and Fantasy
		Data & Analytics Hardware Streaming/ Content Communications Software (added) Security (added) Anti-cheat Streaming Tools AR/VR	Games Engines Developers User Gen Content Distribution Publishers	Conferences Exhibition Events Merchandise Forums & Blogs News Reporting Venues Social Platforms	Academic courses On the job learning DIY/ knowledge sharing platforms	Real-time strategy (RTS) Shooters (FPS & TPS) Multiplayer online battle arena (MOBA) Role- playing (RPG, ARPG, & More) Simulation & sports Puzzlers & party games Action- adventure Survival & horror Platformer	Sponsorship Services Non-Endemic Sponsors Endemic Sponsors	Organizations Leagues Competition Events (Pro Gaming) Tournament Platforms Coaching Service Providers (agencies)	Daily Fantasy Sports Peer-to-Peer Esports Betting
Defence M&S Ecosystem	Technology/ MSaaS	Discover Compose Execute SOA & Cloud Share & Reuse Data & Analytics							
	People	Community Culture Education							
	Process	Process Governance							

Key

- Technology/concept worthy of investigation now
- Relevant but mature/exploited COTS or future concept
- Not currently relevant

HEATMAP – RECOMMENDATIONS FOR TARGETED INVESTIGATION



Key

- Technology/concept worthy of investigation now
- Relevant but mature/exploited COTS or future concept
- Not currently relevant

4 TARGETED INVESTIGATIONS

1. “Verticals”

- a) Games Engines
- b) Cloud Gaming

2. “Horizontals”

- a) Community
- b) Data and Analytics

TARGETED INVESTIGATIONS

TARGETED INVESTIGATION QUAD CHARTS

Games Engines

Background & Overview	Potential Benefits
<p>Games Engines are software-development environments built for the purpose of creating video games and 3D interactive worlds</p> <p>Can be in-house proprietary, licensable proprietary or open source</p> <p>Provide a reusable platform for cost efficiently developing games deployable across multiple hardware platforms</p> <p>Games designers can focus on design, with technology development the focus of the games engine builder</p>	<p>Increasing functionality, vibrant online user communities, content libraries, and shift to professional services support</p> <p>Ease of use and libraries supports rapid simulation composability (depending on the use case), deployable on local and cloud infrastructures</p> <p>Games engines ecosystems include tools such as multi-player, data and analytics, AI, streaming, geospatial, CAD/CAM input making increasingly MSaaS relevant</p>
Exploitability Challenges and Risk	Opportunities
<p>Licensable games engines have been exploited by defence for many years as an alternative to bespoke simulation software, particularly for 3D visualisation</p> <p>MoD takes "laissez-faire" approach to games engines, not realising reusability benefits of coordination, knowledge sharing and data provision and sharing</p> <p>Sometimes remains more cost effective to exploit bespoke</p>	<p>A more proactive MoD stance on games engines to fully realise their potential</p> <p>Separate the management of simulation models and data away from simulation/games engines</p> <p>Catalogue and share where games engines are being used</p> <p>Explore and test games engine-based MSaaS</p>

Cloud Gaming

Background & Overview	Potential Benefits
<p>Cloud gaming runs games on remote servers and streams them directly to a user's device, placing less reliance on local processing, enhancing ease of use and deployability across multiple hardware devices</p> <p>Cloud gaming is a reality and maturing such that issues such as latency have been largely overcome</p> <p>Most gaming and tech companies are now providing cloud gaming services with subscription access to a catalogue of games and/or as a platform for user's own games</p>	<p>Has many of the attributes of MSaaS from a user perspective and can provide near frictionless access to content</p> <p>"Cloud simulation", if fully realised, would reduce local hardware issues, enhance security, enhance data capture and analytics and provide enterprise-wide cost-effective M&S capabilities</p>
Exploitability and Challenges and Risk	Opportunities
<p>Some debate whether current cloud gaming can be made profitable and thus its long-term sustainability</p> <p>Cloud gaming challenging for multi-player games (Polystream may be a suitable alternative approach)</p> <p>Likely a "cloud simulation" approach would need dedicated defence IT infrastructure</p>	<p>Attributes are worthy of consideration by defence as a model for M&S delivery, and support and technology watch/demonstration</p> <p>Use to set requirements for future defence IT infrastructure</p> <p>Integrate DASA-funded Polystream research integrated into MAAITEE (Improbable?)</p>

Data and Analytics

Background & Overview	Potential Benefits
<p>The online nature of gaming and the capture of data supports gaming company's ability to understand gamers' behaviours and needs and generate insights for product development, monetisation and marketing</p> <p>Esports and gambling driving new player data capture and analytical techniques to support player development and tracks trends</p>	<p>Trend towards more quantitative than qualitative training design and assessment chimes with advances in gaming analytics</p> <p>Money behind gaming industry likely to progress many physiological measurements techniques</p>
Exploitability and Challenges and Risk	Opportunities
<p>Potential challenges in transferring knowledge and techniques from gaming to training worlds</p> <p>Defence training systems are stovepiped and disconnected compounding difficulty of comparing data from one training system to another</p>	<p>Establish research activity exploring training data and analytics tools and techniques, learning from gaming industry and considering training metadata challenges and opportunities</p> <p>A DASA call on training data and analytics reaching out to gaming industry might be valuable</p>

Community

Background & Overview	Potential Benefits
<p>Gamers have come together where practicable to play, share and learn, for example MMOGs, but as online capabilities and games engines improve this has become easier and more frictionless, supporting ever larger and more vibrant communities across many game genres</p> <p>New software such as Discord is quickly evolving from communications to being community hubs</p> <p>Twitch, YouTube and the like help build communities of both gamers and spectators</p>	<p>Online communities enhance gamer's experience of the game and for the games companies they enhance retention and ultimately help monetise games over a longer time period</p> <p>Gaming community tools and approaches might help alleviate defence M&S ecosystem stovepiping and increase opportunities to share content and best practice</p> <p>Routine and/or remote spectating of simulation training events might have benefits</p>
Exploitability and Challenges and Risk	Opportunities
<p>Defence IT managers may not be willing or able to introduce tools such as Discord or Twitch</p> <p>Simulation projects procured as stovepipes with little incentive, capability or interoperability to share experiences or content</p> <p>Creating a vibrant and sharing Defence M&S ecosystems is a cultural problem as well as technological</p>	<p>M&S Ecosystem community approach encouraged and sustained</p> <p>Research and explore gaming spectator technology and culture and what can be usefully transferred to defence (Polystream Fantom?)</p>

SOME TAKE AWAYS...

Game Engines

- Software such as Unity and Unreal are already being used in defence
- They are becoming ever more capable and versatile and are supported by their own ecosystems, communities, and professional services
- They have large user bases which generate open source training and knowledge
- Defence could benefit by taking a coordinated approach to procuring and deploying game engines and sharing content and best practice on their use

Cloud Gaming

- A technological reality with Amazon, Google, Microsoft, Nvidia, Sony all have services, running over domestic networks and diverse devices
- Aligns with many core Modelling and Simulation as a Service (MSaaS) characteristics
- Defence could look to cloud services such as Steam, Playfab, or Unity, and investigate emerging cloud offerings such as Polystream and Hadean
- Only be fully realised if MoD defines the appropriate network infrastructure requirement and funding for a cloud-ready network

SOME TAKE AWAYS...

Data and Analytics

- A well-established focus across M&S and defence
- There are many emerging technologies in unexpected parts of the gaming ecosystem which could drive new opportunities for defence M&S and defence wide individual and collective training
- Examples include, live player performance analytics in pro gaming/esports and computer vision technologies for esports training

Communities

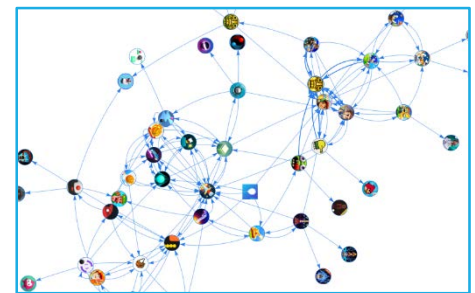
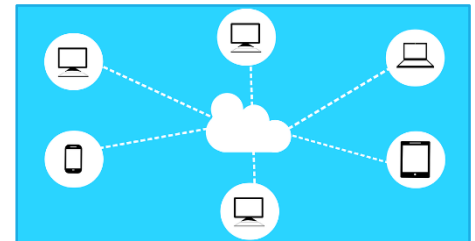
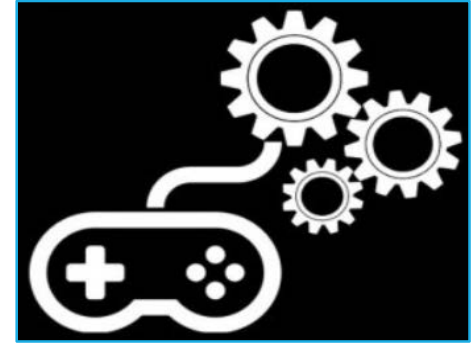
- Connect gamers, spectators, and developers across the ecosystem, empowered by software such as Discord and sharing platforms such Twitch and YouTube
- These communities act as force multipliers, sharing knowledge, providing user-generated content, and experimenting with the technology of choice
- Defence already has bottom-up initiatives such as “Fight Club” and it could reap further community benefit with top-down support to enable M&S communities to mirror the dynamics found in the gaming ecosystem

CONCLUSIONS

TARGETED INVESTIGATIONS

Common interlinked themes emerged:

- The growing potential of game engine and cloud technologies
- Data exploitation for players and businesses
- The value of community in gaming and game development
- The role of a widespread reliable network access as an enabler to innovation, collaboration and sharing



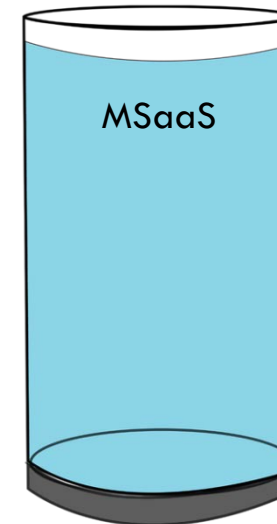
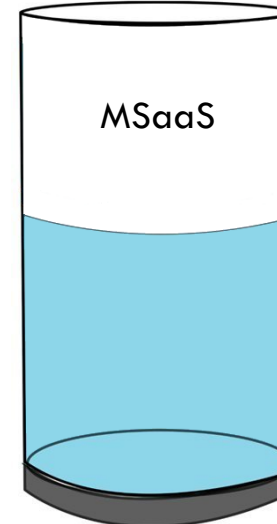
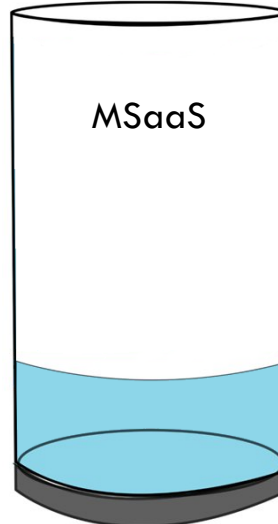
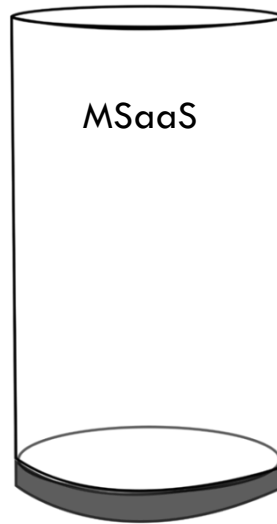
ENTERPRISE-WIDE MSaaS?

Gaming Before



Now
"Gaming-as-a-Service"

The MSaaS
"Glass"



Network
("Digital Backbone")

No Network

No Network

Asynchronous/
Periodic Use Network

Network Always on
High Bandwidth
Low Latency

People &
Process

Do Nothing

Address MSaaS
People & Process

Address MSaaS
People & Process

Address MSaaS
People & Process

OPPORTUNITIES 1/2

Heatmapping

- The heatmapping approach trialled a way of uncovering opportunities for defence M&S to learn from private sector gaming in a highly visual manner
- This method could be reused and might provide a valuable approach for future horizon scanning work

Coordination of Defence Game Engine Use

- Games engines are already being used in defence and defence could see major cost and quality benefit by taking a coordinated approach to procuring and deploying game engines, sharing best practice on their use, and ensuring the content generated can be used elsewhere in defence

Leveraging the Network and Cloud Gaming Approaches

- Cloud gaming is a technological reality now and aligns with many core MSaaS characteristics
- MSaaS will only be fully realised if defence can define the appropriate network infrastructure requirement and provides the funding to deliver a cloud-ready network
- Through a cloud-based testbed, defence could explore leveraging instances of emerging and best-in-class cloud services

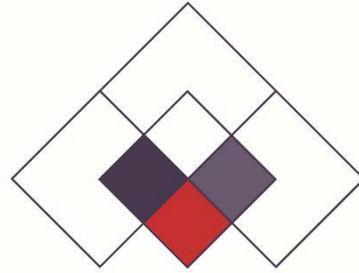
OPPORTUNITIES 2/2

Communities

- Communities are force multipliers, sharing knowledge, providing user-generated content, and experimenting with the technology of choice
- Defence could reap community benefits with top-down support and technologies to enable M&S communities to mirror the dynamics found in the gaming ecosystem

Data and Analytics

- There are many emerging technologies in unexpected parts of the gaming ecosystem that might improve defence M&S data and analytics
- Examples include, live player performance analytics in pro gaming, computer vision (video to data) technologies in Esports streaming, and the use of AI to create digital twins of 'ideal humans'



VEDETTE

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Q&A?

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