



# EXTENDED REALITY - BRIEF

## DETERMINING NEEDS, EXPECTATIONS AND THE FUTURE OF XR FOR THE ICRC

A study commissioned by the ICRC Innovation Board, July - November 2018

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### Summary

Storytelling is common to every culture. It involves a mutually beneficial exchange and is a process we learn to negotiate in infancy. Storytelling builds the basis for how we communicate with each other. But the way we communicate continues to evolve with us and the newest medium allows mere ideas or just collective data to be shared through immersive sensory experiences. It's called Extended Reality (XR) and it is doing more than just changing how we talk to each other. Its ability to overlay real-time data on our view of reality is changing everything from how business is conducted to how wars are waged<sup>1</sup>.

In July 2018, the ICRC Inno Board commissioned a study on Virtual Reality. Initially designed to investigate the feasibility of expanding the work of ICRC's Virtual Reality Unit (VRU), the study broadened as information on the field of XR developed. The final purposes of this study, as overseen by an Advisory Group<sup>2</sup>, were 1) to obtain current information on the internal (ICRC and Movement) level of interest and the needs / expectations for this platform and 2) to understand the main trends, actors and industry projections for XR.

XR is a field that comprises Virtual Reality, Augmented Reality and Mixed Reality. The potential of this platform to alter how we understand our world and each other is extensive; market disruptions are expected in roughly a dozen fields but healthcare, education and the military are the most relevant to ICRC's mandate. Based on current sales and projected service and product launches through 2020, the expected surge in consumer adoption should result in a subsequent, rapid evolution in both access and development leading to a predicted worldwide, ubiquitous use by 2025<sup>3</sup>.

In today's hyper-connected world, supercomputing on smart phones and big data delivered on cheap hardware mean organizations – even humanitarian institutions – can manage resource and financial expectations better with more targeted services. As a vehicle for human interaction and education, XR has the potential to improve and diversify the way the ICRC educates, communicates and represents itself.

<sup>1</sup> See Hartmann, T., 2009 and Hartmann T., 2017

<sup>2</sup> The ICRC Advisory Board for this study includes: Innovation, Virtual Reality, Finance/Admin, Learning & Development, Rights & Protection, and Communication/Information Management

<sup>3</sup> See Goldman Sachs Global Investment Research 2016

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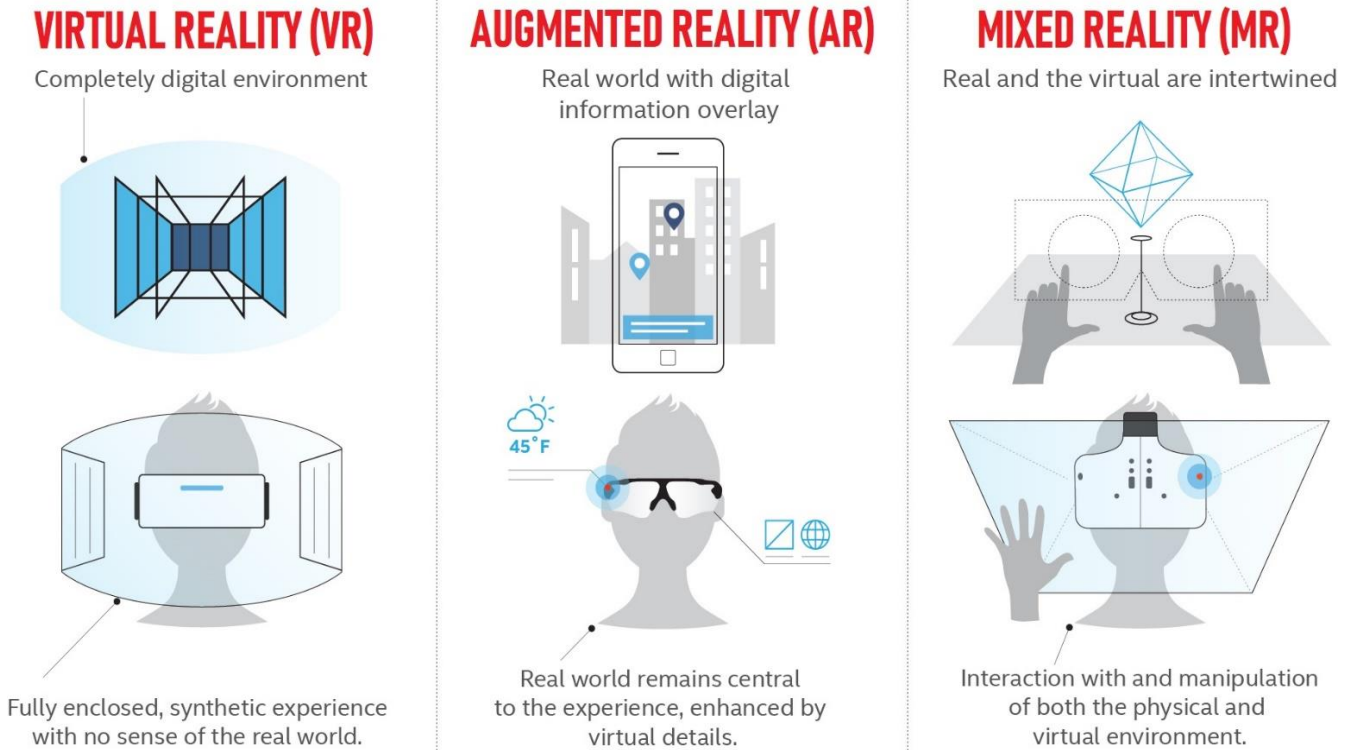
### A VIRTUAL HISTORY

The first recorded attempt at virtual reality was the stereoscope, invented in England in 1838; it used a pair of mirrors and two cleverly placed peripheral drawings to demonstrate the brain's capacity for 3D imaging. The Google Cardboard expands the same design using a smartphone (rather than mirrors) to inverse images at a much more efficient rate but the concept remains the same.

In 1962, the Sensorama was constructed in New York. A large, one-person machine, it provided an immersive, multi-sensory experience building on the novelty of 3D sight by adding sound, smell and touch aspects. This is the precursor for IMAX and 4D/5D films.

But it was at MIT where the first head-mounted device was invented in 1968. Incorporating multi-sensory experience with computer graphics, the headpiece required massive amounts of machinery that had to be suspended from the ceiling; due to its immensity and weight, it was nicknamed the Sword of Damocles. Despite its tremendous size, its subsystems became the basis for VR HMDs and AR interfaces of today.

## Part 1. What is Extended Reality (XR)



As a computing platform still in development, finding consensus on concrete definitions can be elusive; currently XR is an umbrella term that comprises Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) but is not limited to these three. XR can also refer to any current or planned human-computer interface that builds upon the relation of graphic technology with a wearable device. As a field that encapsulates a broad spectrum of the human experience – everything from psychology to flight simulations – the potential for inclusivity and development is enormous.

Currently the most common form of extended reality is **Virtual Reality (VR)**. It is generally defined as an interactive computer-generated experience within a simulated environment, whereby the user completely inhabits a synthetic world. In VR, reality and the synthetic world do not interact, nor does the user interact with the real and synthetic world simultaneously. Several types of VR exist with varying levels of inhabitation. The most immersive possibilities require an **HMD** or **cave** to completely separate the real from the synthetic environment, but **desktop** VR utilizes computer graphics to develop a synthetic, inhabitable 3D environment with only a personal computer. **Video mapping** turns common objects or rooms into a 3D display and **360 films** place a single user into an entirely digital environment (whether live action or computer-generated). The humanitarian sector<sup>4</sup> mainly utilizes VR 360 film, which is the least expensive and time consuming to produce.

**Augmented Reality (AR)** is a continuation and evolution of VR. While also an interactive experience, in AR the user can interact with the real world and the synthetic information simultaneously. It layers virtual information or graphics over the user's view of the real world; however, the real world and the virtual content do not interact with each other in real time. The first AR application was utilized back in 2011 by Crisis Commons and **OpenStreetMap** in response to the Haiti earthquake.

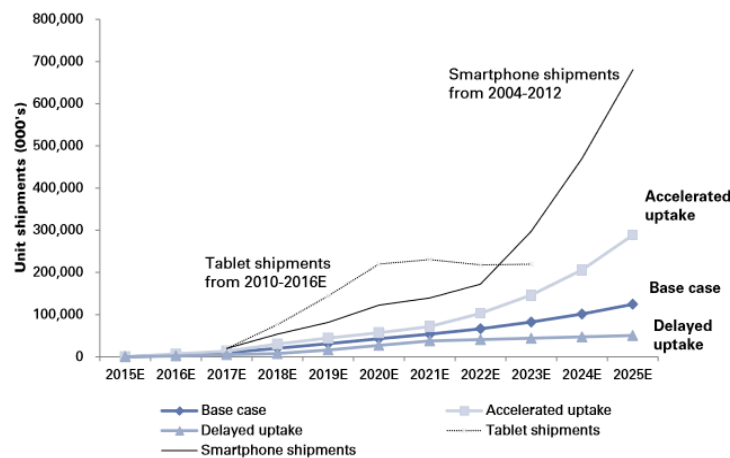
**Mixed Reality (MR)** is the best of both VR and AR. In this platform, the virtual information is overlaid as well as anchored in the real world; virtual graphics can interact with real world structures. As the newest version of XR, this may be called several names, such as merged reality, hybrid reality or augmented virtuality.

<sup>4</sup> See the International Organization sector in Part 3 of this report for examples.

## Part 2. What is Extended Reality in the World

First developed (in its current form) in the 1960s as a result of an electrical engineering student developing human interaction with computers<sup>5</sup>, VR has slowly increased and expanded its footprint in the world. Throughout the 1970 and 80s some markets were able to find cost reduction benefits to VR, like flight and crash simulations for the airline and automobile industries, and surgical trainings in the medical field. Yet while currently enjoying most VR profits, the entertainment industry had previously found it very difficult to sell. 3D video games were launched in 1987, 1995 and 2011 before finally becoming profitable and this can be largely attributed to hardware and software developments<sup>6</sup>.

The home computers of 15 years ago were not powerful enough to render realistic VR and graphics on PCs were in sharp contrast to Hollywood's depictions of virtual worlds in film; the comparison left consumers disappointed. But even today's smart phones have higher quality display, sensors and accessibility than its computer predecessors of only a decade earlier. As well, the prices and sizes of both computers and phones have also continued to drop, increasing personal mobility and industry sales.



Source: Goldman Sachs Global Investment Research, IDC.

Goldman Sachs compares global sales of smart phones between 2004 and 2012 against sales of computer tablets from 2010 to 2016 to demonstrate the interaction of individual and enterprise-driven sales on a market<sup>7</sup>. Smart phones began as a professional tool that created consumer demand once more functionality was incorporated; the industry built upon voice and text messaging by adding email, internet, video and social functionality to a pocket-sized mobile office, thus disrupting the desktop computer market. While smart phones began as enterprise-driven, tablets initially targeted individuals and resulted in a quick upsurge in sales that plateaued once consumers determined it was not a replacement but an evolution of the computer. Enterprise was the driver for the PC and the consumer continues to drive the smart phone, but the combination of enterprise and consumers will drive XR development into the future<sup>8</sup>.

It wasn't until Google introduced its augmented reality glasses, Google Glass, to the public in 2012 that (what was to become) XR gained traction for consumers. This continued when Facebook acquired Oculus for USD 2 billion in 2014 and interest from both businesses and consumers continues to grow in large part due to visual graphic development in the video game industry<sup>9</sup> and the wider mobility offered from smart phones.

<sup>5</sup> Jaron Lanier, MIT, 2017

<sup>6</sup> Goldman Sachs Global Investment Research, 2016

<sup>7</sup> Goldman Sachs Global Investment Research, 2016

<sup>8</sup> Bellini, 2018

<sup>9</sup> Roeth, 2018

Since 2012, 12 companies have led investments into VR and AR start-ups. In a two-year period, the value of capital investments made was roughly USD 5.5 billion; this is more remarkable when compared to VR and AR's global market size of USD 6 billion for 2016. The North American region currently dominates the marketplace, accounting for the largest global market share in terms of revenue, but XR is playing into an even larger global videogame market currently estimated at USD 106 billion<sup>10</sup>.

Company	Date	Details
Qualcomm	Jan-12	Raised seed funding for the mobile augmented reality startup Blippar
Google	Apr-12	Introduced augmented reality glasses, Google Glass, to the public
Sony	Mar-14	Sony announces Project Morpheus, later renamed PlayStation VR
HP	Mar-14	Launched Aurasma 3.0, an augmented reality platform that it acquired through Autonomy
Facebook	Mar-14	Acquired Oculus, a virtual reality startup, for \$2bn
Samsung	Sep-14	Revealed its own head-mounted display, Samsung Gear VR, partnering with Oculus
Google	Oct-14	Invested \$542mn in the startup Magic Leap
Intel	Apr-15	Invested in Series A funding for the virtual reality startup WorldViz
Apple	May-15	Reportedly acquired Metaio, an augmented reality software maker
Disney	Sep-15	Led a \$65mn funding round in Jaunt, a VR content startup
Microsoft	Oct-15	Acquired Havok, a 3D physics engine used for videogames
Comcast & Time Warner	Nov-15	Participated in a \$30.5mn funding round for NextVR, which captures live events in VR
Apple	Nov-15	Acquired Faceshift, a facial recognition capture and animation company
Fox	Jan-16	Acquired minority stake in Osterhout Design Group, a VR/AR HMD maker

*Source: News sources, compiled by Goldman Sachs Global Investments Research.*

Videogames are the most profitable conduit for XR today but that may not always be the case. The **healthcare** field is experimenting in everything from new educational approaches to hands-free medical tools. It is expected to generate more than USD 5 billion on its own by the year 2025, making it the second largest (and fastest growing) market to absorb XR<sup>11</sup>. The XR platform will allow patients to observe surgical procedures prior to their own intervention, as well as provide optimal training and practice guides for surgeons, building trust and comfort while reducing the cost of care. It can be used to overlay real-time data onto live surgeries, treat certain mental illnesses and has been proven to reduce dependency on pain medication<sup>12</sup>. There is already a substantial patient monitoring device market, currently worth USD 16 billion<sup>13</sup>, that XR may disrupt or play into by providing a new way to monitor patient progress from afar.

The US **military** has been using VR technology for training since roughly 2012<sup>14</sup>. Many US military trainings are already done using simulations, as opposed to live exercises, with a focus on flight, battlefield and medic training. This is the most practical adoption of the technology as simulations are much more cost effective than training in actual fighter jets, hence the military being an early adopter of the platform. XR military applications include combat training, mission rehearsal, concept development, material design and testing, medical training and personnel selection. With 6.9 million military personnel in high-income countries<sup>15</sup> and an average annual VR software cost of USD 2,000, financial projections for the global impact of XR in the military<sup>16</sup> market may be substantially underestimated<sup>17</sup>.

XR technology has massive potential to change how **education** is delivered around the world. According to World Bank statistics for 2016, there were 200 million primary and secondary students in developed

<sup>10</sup> Bellini, 2018

<sup>11</sup> Goldman Sachs Global Investment Research, 2016

<sup>12</sup> Forbes Inc, 2017

<sup>13</sup> Grand View Research Inc, 2017

<sup>14</sup> US Department of Defense, 2018

<sup>15</sup> The World Bank – IBRD – IDA, 1985-2016

<sup>16</sup> US Department of Defense, 2018

<sup>17</sup> Goldman Sachs Global Investment Research, 2016

countries; while that number is steadily increasing, government investment in education is globally decreasing<sup>18</sup>. With XR, teachers will be able to immerse an arrested audience inside a 3D environment that can capture real-time data to monitor progress and test retention. However primary and secondary schools are not expected to be large profit generators but merely grounds for establishing and training new users (as with the computer). Universities, on the other hand, may develop targeted curriculum that adopts XR technology in specific markets such as health, engineering and commerce<sup>19</sup> to prepare the next generation of the labor market.

The user experience will be the most important indicator for the future success of XR. The display interface must develop richer visual content that allows a seamless switch between realities; virtual objects in augmented realities must be indistinguishable from real objects in the same view, with common illumination and intuitive tracking technology. The user must also have complete mobile access, and this is connected to the launch of 5G mobile broadband.

Piloted in the US, Japan and South Korea in 2018, 5G received immensely positive feedback<sup>20</sup> and is projected to be launched in these countries in 2019, followed by most of the developed world in 2020. 5G promises exponentially faster downloads than 4G with minimal latency<sup>21</sup> (even though it is yet to be proven for XR video rates). There must also be a balance between affordable hardware and accessible software and this is being addressed on both ends by companies like Facebook, Google, Sony and Microsoft. Price will indicate success; the price for hardware should be expensive enough to denote worthwhile being affordable enough to allow access.

Based on current sales and projected service and product launches through 2020, the expected surge in consumer adoption will result in a subsequent and rapid evolution in both access and development. Once consumers can easily access a variety of XR features (think social interfaces, games, health applications or e-commerce) on any mobile device, the market will be on course to reach a state of maturity leading to worldwide, ubiquitous use by 2025<sup>22</sup>.

## Conclusion

The humanitarian field has identified the XR computing platform as an excellent fundraising mechanism; a way to elicit an emotional response from the public and create more loyal donors. However, fundraising is just the beginning of possibilities for the humanitarian sector. XR has the potential to become a more natural, more intuitive computer interface that allows a person to focus more on the task than the tool.

Embodied cognition is the theory that thought is not confined to the brain; the experiences of the body also affect mental constructs and performance on tasks. This idea of singular achievement through collective effort is also representative of the ICRC. Nothing is done independently by a single unit nor do only a few people benefit; it is a collective endeavor and the result of internal expertise combined with shared knowledge that serves an immensely valuable and global need.

Enactivism is the basis of Extended Reality; every sense is provoked to create an honest, realistic experience that engages and responds to the entire body. As humanity's newest tool for storytelling, XR highlights the endless possibilities to reach each other in ways that combine value with economy, proximity with distance, caution with risk. More than just aligning to similar markets, using XR for humanitarian work means planning for inclusivity, presenting a universal message and preparing for the global reply.

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<sup>18</sup> The World Bank – IBRD – IDA, 2016

<sup>19</sup> Grand View Research Inc, 2017

<sup>20</sup> O'Malley, November 2018

<sup>21</sup> Qualcomm Technologies Inc, 2018

<sup>22</sup> Goldman Sachs Global Investment Research, 2016

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