Towards an inclusive curation of WWI heritage: integrating historical aerial photographs, digital museum applications and landscape markers in "Flanders Fields" (Belgium)

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Abstract

Purpose – Over a century of state-sponsored construction of monuments, historic mythmaking and nationalist framings of WWI has ensured that it has become notoriously difficult to present the heritage of the Great War in an inclusive and non-selective way. In this paper the authors present a strategy and technology-driven solutions to overcome the selective heritage curation of modern conflict.

Design/methodology/approach – Building on a suite of tools, applications and cultural heritage management plans developed by the In Flanders Fields Museum (IFFM), this paper explores the challenges of preserving and curating conflict heritage. The authors investigate the philosophy, cultural heritage management strategies and exhibitions used to curate the heritage of the Ypres Salient (Belgium).

Findings – The paper argues that historical aerial photographs integrated in multimedia exhibits present themselves as a fascinating source bringing the landscape within the walls of the museum. Mobile augmented reality (AR) applications developed by the museum go one step beyond and bring museum techniques to the landscape.

Research limitations/implications – This paper presents a strategy to present, manage and curate the entirety of conflict heritage from the modern period. Faced with growing politicisation and memorialisation of modern conflict, it is extremely important that inclusive heritage management and curation is insured. The reflections on different curatorial techniques used by the IFFM can contribute globally towards a better heritage engagement.

Practical implications – An innovative and meaningful framework enables a more historically nuanced visitor experience to key heritage sites throughout the Ypres Salient.

Social implications – Ensuring a non-selective heritage experience is especially pressing today. Over the past century canonised and national narratives have prescribed our understanding of the First World War across Europe and beyond.

Originality/value – Adopting a critical stance towards the proliferation in AR apps and applying theories from anthropology and phenomenology has been developed combining AR with arboreal landscape relics.

Keywords Landscape, Heritage, Cultural heritage, Museums, Site management, Heritage management, Documentation, Surveying and recording, Post-conflict heritage

Paper type Research paper

1. Introduction

Ensuring a non-selective engagement with twentieth century modern conflict is notoriously difficult due to the structuring impact of official *lieux de memoire* (Nora, 1989; Winter, 2006). Canonised narratives, state-sponsored memorials and representations in popular culture prescribe what, and who, is remembered and presented to the public today. This is especially the case for the Ypres Salient, one of the major theatres of "the Great War" (1914–1918), where a few hallmark locations connected to infamous battles define the memory culture of the war. Reporting during the war in national newspapers about heroic battles and the equally patriotic construction of memorials after the war ensured that places like Passchendaele, Hill 60 and Ypres have become metonyms for the First World War (WWI). Places and sites absent in monumental memorials and in the collective memory, however, are left out of the canonised limelight and often have alternative histories encoded in them become forgotten as the last witnesses of the war have passed away (Chielens, 2006).

Dominant historic imaginaries textured by nationalism structure the heritage infrastructure of WWI along the Western Front, presenting heritage professionals and researchers with serious challenges. In this article we present the philosophy, cultural heritage management strategies and digital heritage applications developed by the In Flanders Fields Museum (IFFM, Ypres) to counter such a canonical interpretation and presentation of the cultural heritage of WWI. At the heart of this approach lays the conceptualisation of the "landscape as the last witness" for interpreting, experiencing and managing the heritage of modern conflict. Building on research within the fields of conflict archaeology and heritage management (Cantoro *et al.*, 2017; Nocerino *et al.*, 2018) and discussion in historical and contemporary archaeology (Clarke *et al.*, 2017; Deetz, 2013), we argue that visible and buried traces of the war (in the form of archaeological features and sites) preserved in the landscape today are amongst the most powerful touchstones that can be used by local heritage practitioners and museum experts to recount the full history of conflicts like, but not limited to, WWI in less selective ways.

However, because of the former battlefield's vastness and the buried nature of the majority of WWI sites ensures that producing a meaningful audience engagement with archaeological landscapes remains extremely difficult. In this article we present a technology-driven strategy for a counter-canonical heritage engagement that provides a pathway forward. This methodology is based on an integration of state-of-the-art archaeological techniques for heritage documentation, a non-centralised museum experience with different outposts on key places in the warscape, mobile augmented reality (AR) applications and the use of subtle physical beacons on the ground.

We contend that a meaningful heritage experience can only be achieved if these different elements are used in conjunction with each other. Over the past decade the cultural heritage field has become enchanted by the promise and opportunities provided by AR and mobile apps (Angelopoulou *et al.*, 2011; Blanco-Pons *et al.*, 2019; Bruno *et al.*, 2010). However, recent user engagement research (Dieck and Jung, 2018; Barbieri *et al.*, 2017), reflections by heritage theorists on the importance of experience design (Perry *et al.*, 2017), theoretical perspectives on the materiality of associative landscapes in entangling people with place (Rössler, 2006; Ingold, 2000), explorations from critical heritage studies (Economou, 2015) and our own experiences with mobile applications, teach us that as in a stand-alone setting any AR initiative fails to effectively engage a diverse audience. Rather AR and mobile apps need to be inserted in a wider strategy. In this paper we will present such a strategy, specifically tailored to archaeological landscapes of modern conflict.

In the approach developed below we will present and evaluate the different exhibition strategies the IFFM has developed over the past years. In the first section we briefly describe the theoretical framework of the used heritage strategy and the methodologies and sources used to systematically map the WWI warscape. Subsequently we will reflect on the strengths,

weaknesses and comparison of user metrics of the applications and tools developed to present this rich cultural heritage to the public. Following this we will describe the current integrative approach, which is the natural outcome of reflection on past applications and a deeper theoretical reflection on landscapes and cultural heritage.

2. The landscape as the last witness: a big data method for mapping modern conflictscapes

One of the defining characteristics of the cultural heritage of the so-called "super modern" period is its vastness (González-Ruibal, 2008). This period, coinciding with the timeframe WWI–present, distinguishes itself from older archaeological eras because of mass production and quasi-industrial building techniques. This means that the material legacy of this period is not only abundant, advances in construction techniques ensured that building activity exploded and entire landscapes could be redeveloped within months. On the WWI Western front an entire landscape consisting of defencive and logistic infrastructure was built at an unprecedented scale covering vast areas. And as the front evolved, this warscape shifted and could be drastically reordered in a few months.

For heritage practitioners and archaeologists this super-modern heritage provides serious challenges compared to other types of heritage. First, because of its vastness both in quantity and geographical encompassment, the material legacy of this past cannot always be singularly researched and presented through a traditional site-based approach. Second, as a direct result of this richness in material remains, there is the tendency to select a few key sites as mnemonic touchstones for narrating the history of the conflict. Very often, these sites and their interlinked histories embody those official histories structuring the socio-political landscape of that post-conflict setting. Examples from critical heritage studies teach us that such an "authorized heritage discourse" is often selective and imbricated with nationalism (Smith, 2006). This is not different for dark heritage related to conflict and war (Thomas *et al.*, 2019; Macdonald, 2009).

The latter issue remains perhaps one of the key challenges for those heritage professionals and researchers of the Western Front of WWI. According to Jansen-Verbeke and Georges (2015) in Belgium the genealogy of the selective memoryscape of WWI—that part of the landscape that is actively remembered and preserved through monuments and official histories—finds its origin at the end of the conflict. A period when the victors (spearheaded by the Commonwealth states) erected the first monuments and appropriated key sites to bolster nationalism. The subsequent century of selective remembrance, historic mythmaking and politicisation of the heritage of WWI (Holbrook and Reeves, 2019; Winter, 2014) has ensured that when visiting the region a very one-sided story predominates. One in which there is limited room for subaltern counternarratives (for example colonial dimensions of the war or the victim's side of the story). The founding principle of the IFFM has always been to promote a more inclusive and cosmopolitan approach to the war, countering those (often white) nationalist myths and heroic metanarratives promoted through sites such as Passchendaele (national site of memory for Great Britain, Canada, Australia and New Zealand), Langemark (Germany) and Diksmuide (Flemish nationalist movement).

At the same time, conflicts in the super modern period are unique because of the large amount of historical geographic data produced. For example in the case of WWI, the ever increasing availability of big data of historical documents, maps (Chasseaud, 1991) and historical aerial photographs taken during the conflict (Finnegan, 2006) is unlocking the potential to redirect the focus from a site-oriented approach to a landscape-oriented research angle (Saunders, 2012). Especially the availability of modern remote sensing techniques, used in combination with systematically georeferenced historical aerial images, has enabled archaeologists in Belgium to map and understand the WWI warscape beyond canonised

national framings of the war (Stichelbaut *et al.*, 2016, 2017). This warscape, which is still preserved either as buried archaeological heritage or visible remains, ultimately presents itself as the "last witness" of the war. Now that the generation who bore witness to the war has passed away, it is no longer possible to have an interpersonal connection with the war. Only those buried remnants remain as anchor points that can counter dominant reifications of the war.

Throughout WWI, millions of aerial photographs were taken across the various theatres of combat. Whilst originally taken for the purpose of military intelligence (Finnegan, 2006) these photographs were analysed to investigate the surface features (Stichelbaut *et al.*, 2016), buried archaeology (Saey *et al.*, 2013) and reconstruct the conflictscapes (Gheyle *et al.*, 2013). A large-scale digitisation project provided a primary dataset of over 30,000 historical aerial photographs for the area covering the western part of Belgium and northern France. After careful geolocalisation of the historical photographs, all visible features on the historical imagery were mapped in GIS.

Using this mixed methods approach, including airborne LiDAR (Light Image Detection and Ranging) data, the archaeological landscape of the northern part of the Western front was reconstructed (Gheyle *et al.*, 2018). For the region central to this paper (Ypres Salient), a total of 9,054 georectified historical photographs were used. In the region of 617 km^2, all features related to WWI were digitised. This dataset provided an unprecedented insight into the density, distribution and diversity of the WWI heritage (Stichelbaut, 2011; Stichelbaut *et al.*, 2017).

Geophysical research (Note *et al.*, 2018) and test excavations were used to identify unknown features. All archaeological sites visible on the historical aerial photographs were compared with the LiDAR to evaluate preservation conditions. In total 162,417 individual features, 3,525 km of trenches and 5,000 km of transportation infrastructure was documented for the study region. All these remnants of the war were related to the five major battles that took place during the war in the region, at a cost of over 500,000 human lives. When confronting the warscape documented using archaeological remote sensing techniques with the known "memoryscape" (Clack, 2011), memorials and military cemeteries, one is confronted with a substantially more complex and diverse warscape. In the end, the totality of all (often buried) archaeological remains, and its material endurance, presents itself as a "counterscape" to the canonical imaginaries of the warscape. Meaning that heritage hitherto invisible due to the dearth of monuments or attention in popular culture is now made visible and forces us to include this in heritage management and communication (see Figure 1 and Plate 1).

3. Bringing the landscape in the museum: In Flanders Earth as an interactive multi-touch application

In 2012 the renewed IFFM set out to fully integrate this philosophy in its new permanent exhibition. A diverse range of tools were employed to highlight the war landscape and archaeology of the Ypres Salient. In addition to excavated archaeological objects a multitude of historical aerial photographs and documentary films were employed throughout the museum. Perhaps one of the most powerful objects on display (Figure 2) that symbolises this notion of the last witness is a section of tree trunk from an oak that grew in the park of Elverdinge Castle between 1760 and 1994 (Haneca, 2014). The tree rings that date back to the years of war bear black scars caused by exploding artillery shells. Afterwards the tree formed new wood around the wounds and preserved these faint traces for almost a century (Chielens *et al.*, 2012).

The Elverdinge tree trunk is exhibited below the spider-like framework of the In Flanders Earth application (Figures 3 and 4). This Google Earth inspired display provides a "then and now" comparison of historical and contemporary aerial photographs. Over 3,400 georectified
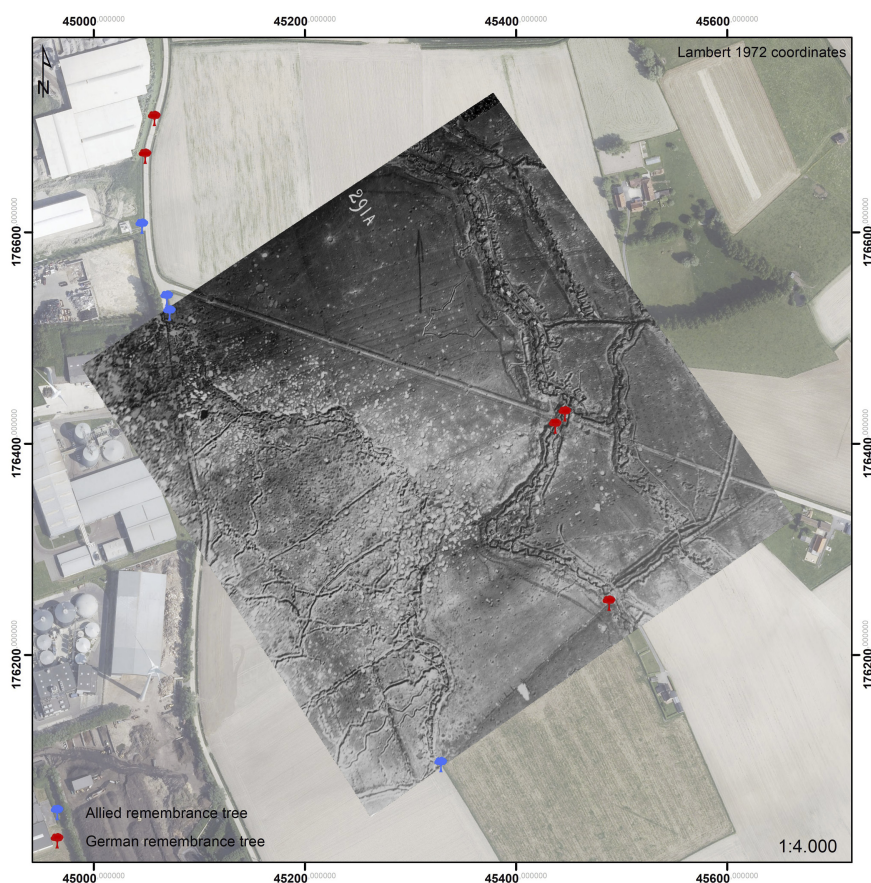
historical aerial photographs offer a glimpse into the past destruction of the landscape, the dense networks of trenches and military infrastructure, and the elaborate case studies supplementing aerial photographs with other documentary sources support this (Stichelbaut and Chielens, 2016). Because the traces of WWI are often only visible to the trained eye, museological techniques were developed to render it visible for visitors. Visual clues, explanatory texts and images from the ground help visitors in interpreting what happened in very diverse places, including both areas at the front and far behind infantry lines.

The content of the application is targeted at both inhabitants of the region and numerous visitors. Inhabitants of the western part of Belgium are mostly interested to see what "their" region or street looked like during the war. They can easily navigate the multi-touch screens by clicking on an inset map, using multi-touch gestures or typing a place name into the integrated GIS gazetteer. Visitors from outside the region usually have fewer personal connections to the region are and are especially fascinated by the overall story of the Ypres Salient or places linked to their own family history. For them, 170 case studies have been developed narrating a large range of stories and histories. These range from hotspots in the trench warfare, to explaining the genesis of military cemeteries and to highlighting the diversity of sites which can be seen such as airfields, supply infrastructure, destroyed villages and cities etc.

Plate 1.
Cropmark of a typical British First World War trench with regular square traverse near the village of Wijtschate, photographed in 2017 (photo: In Flanders Fields Museum)

Figure 2.
Elverdinge tree trunk and the Flanders Earth installation

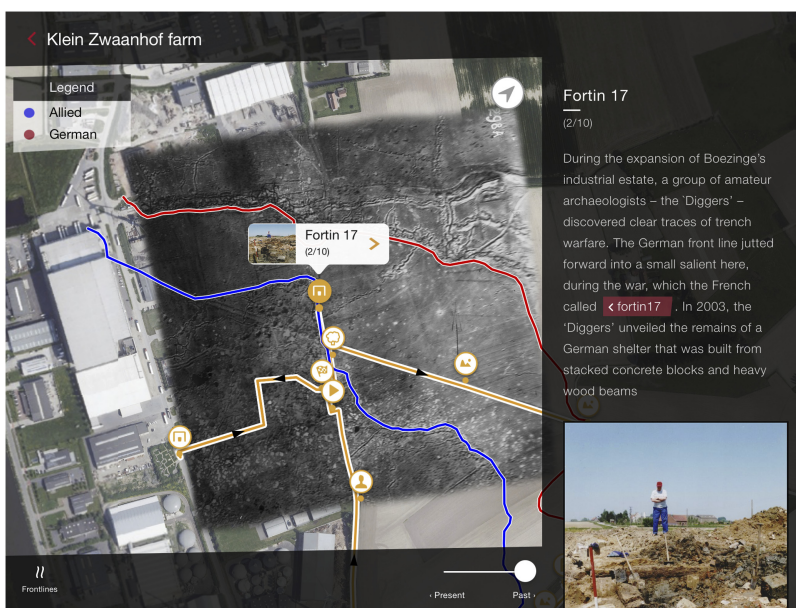**Source(s)**: In Flanders Fields Museum

While the In Flanders Earth application was the first of its kind during the development phase, similar museum setups have since emerged. The Australian War Memorial's "Australia in the Great War" exhibition includes an "Anzac from the Air" display that highlights the 1915 Australian-Turkish Gallipoli battlefield from an aerial perspective (Diggins *et al.*, 2016). Other applications have also been created in Italy and Slovenia (Cuttini,

Source(s): In Flanders Fields Museum

Figure 3.
In Flanders Earth
application interface
and framework

Source(s): In Flanders Fields Museum

Figure 4.
Screenshot of the
application showing
one of the POIs: the
button at the bottom
left "Frontlines"
toggles the red
(German) and blue
(Allied) frontline; the
slider at the bottom
right blends the
historical aerial
photograph with a
modern orthophoto
and the text
highlighted in red
toggles an annotation
on the photographs

2016). The most recent application was launched in 2015 by the new museum Lens 1914–1918 at Souchez (France) where over 6,400 WWI aerial photographs covering the front in Artois and French Flanders were mosaicked and made accessible on a 5 × 1 m touch screen confronting the viewer with wartime images of destroyed villages.

These applications have one thing in common: they all bring a landscape of the past within the museum walls to confront the visitor with the totality of conflict and the full range of sites and types of heritage connected to the War. A visitor survey at the IFFM–that received

1,736,758 visitors during the centennial commemorations – revealed that the In Flanders Earth application was mentioned by 1 out of 12 visitors as the most interesting multimedia setup in the museum (In Flanders Fields Museum and Westtoer, 2013), signalling the applicability of the chosen approach in disseminating WWI heritage. Despite its success in engaging the public and enabling them to grasp the totality of war, the application still provides the visitor with a relatively distanced experience of the warscape. Although the 2D bird's eye view has the strength to establish interrelations between sites, both responses from visitors and anthropological perspectives on cultural landscapes and museums (Bender, 2002) teach us that GIS-like top-down representations of historical environments threaten to detach the visitor from the full phenomenological experience of the event: real human suffering and death can become a mere dot on a map or a statistic.

4. Museum in the landscape: entry points and AR solutions

To ensure a full sensory engagement with the last witness of the war, the IFFM joined forces with the council of Ypres to not only bring the landscape into the museum, but also to bring the museum to the landscape. An AR mobile application, in combination with physical museum outposts (including small room-size buildings that are unstaffed), were developed. In 2015 three, thematically different and lesser known, entry points into the Ypres Salient were selected. Each outpost consists of a small exhibition providing historical context and introductory films provide visitors with the required knowledge to discover and understand the war remains, relics, monuments and cemeteries near the entry points. The entry points are set up as the starting point for a series of heritage walks into the landscape through an AR guided app.

Research suggests that young visitor groups show limited interest in war heritage (Winter, 2010). This is something we also noted at the IFFM where over 50% of the visitors are older than 50 and a mere 8.5% is between 25 and 40 (Westoer, 2009). By using the familiarity of technology the hope was that interest would be aroused within this younger generation. The combination of geolocated historical aerial photographs and mobile tablets or smartphones equipped with gps-positioning opens up new possibilities for visualising buried archaeological sites and showing the extent of trench warfare at the Western Front. Due to the use of technology and medium of the tablet or smartphones, the target audience for this application is mainly, but not exclusively, digital natives.

In the framework of the European project "Archaeolandscapes" (www.arcland.eu) a mobile application "Ypres Salient 1914–1918" was developed to have visitors engage with historical aerial photographs and thus enhance the visitor experience at battlefields. Within the app a guided walk is offered along the former battlefields. Along the route visitors are are provided with historical narratives and photographs of the exact places. The application is not a digital version of a paper brochure or map but makes the most of available technology, especially with the geolocalisation capabilities of the devices. Over the different historical walks, roughly between 2.5 and 4 kilometres in length, visitors have the ability to walk on top of former battlefields by means of time series of geolocated WWI aerial photographs. The visitor's position on the historical landscape is shown by a "blue dot" that moves in real-time as he or she moves. Along each walk there are between 10 and 12 points of interest (POI) focussing on landscape relics (bunkers, mine craters, former trenches) memorials (cemeteries and commemorative markers) and associated historical narratives (personal stories linked to individual headstones in cemeteries) that can be directly linked to specific places by means of historical aerial photographs.

As soon as a visitor approaches such POI, a geo-fencing function is activated and the content is loaded. In between the POIs the user is able to explore time series of aerial photographs and track the evolution of the landscape destruction at the place he or she is walking. Visitors or users of the application have no prior knowledge of aerial photography. To overcome this difficulty the design makes use of interpretation keys which are indicated in

the text and can be toggled on and off. These correspond to highlighted areas on the aerial photographs in order to ensure a link between textual content and aerial photographs. The same applies for the annotation of Allied and German frontlines which are provided as a reference framework for orientation within the historical landscape. There is a functionality included to blend the past and present-day aerial photographs so that users can actually "see" the trenches and frontlines in the landscape. Currently three walks are available and have been developed and published in the App Store (iOS) and Google Play Store (Android). The app is free of cost and the content is made available in English, Dutch, French and German.

The question emerges: what is the advantage and added user experience of the application? The general history of the Allies and the Central Powers stalemate in the trenches is widely known. The dense networks of trenches on both sides of a narrow no-man's land is easily comprehensible from a bird's-eye view, but very few people can translate this to the actual terrain and realise the sheer extent and scale of the field defences and destruction. As indicated by Tim Ingold (1993), a "dwelling perspective" helps in overcoming the separation between man and landscape and enables the imagination of the temporality of a place. For Ingold the best way to engage with the multilayered-ness of a landscape is by being in the place and perceiving it "through the feet" (Ingold, 2004).

The mobile application is designed to enhance this engagement with the landscape through walking and "footwork". It enables users to stand on the German or Allied lines, cross into no-man's land or stand on enemy lines and buried trenches. The app emulates an experience in the field of how close to each other the frontlines really were; one can see the distances in open terrain that needed to be crossed during trench raids or offensive action and can understand the relationship between the local terrain and the frontlines. Even in a flat landscape such as Flanders, the advantage of holding a "hill" of a few metres altitude could mean the difference between seeing and being seen. The historical aerial photographs provide contextual information and place landscape relics, cemeteries and sites within their landscape context.

At the most northern entry point, for example, visitors encounter the small "Caesar's Nose Cemetery" where 68 fallen British soldiers were buried in the middle of a field. The aerial photographs provide visual clues to interpret the cemetery. The cemetery is located in the former no-man's-land between the Allied and German lines. Most soldiers buried here died just prior to or during the opening days of the Third Battle of Ypres (31 July 1917–10 November 1917) and are buried in no-man's-land: an area which was not already occupied with trenches and not too heavily damaged with shell holes, a clearly pragmatic approach. At the cemetery the app provides visitors with the tools to see the relationship between the cemetery and the frontlines that are now only preserved below the surface as archaeology. The name "Caesar's Nose" refers to a remarkable bend in the German frontline trench which becomes apparent on the aerial photograph and is also annotated as such to draw attention to it. Additionally the application provides personal stories of a number of fallen soldiers on the cemeteries, to humanise the otherwise uniform white gravestones. The app links these war histories and personal narratives to the landscape and helps foster understanding of the war terrain in Flanders Fields.

Besides offering visitors the possibility to increase the quality of user experience by engaging more profoundly with the warscape of WWI, user metrics show that the AR application is also successful in reaching the audience that had hitherto been least interested in battlefield touring. Analysis of the user data shows that the app was especially popular in mobilising people from the group 30–35 years in using the app to discover the warscape, which is relatively younger than the average battlefield tourist.

5. Enhancing the visibility of memorial trees
This strategy combining physical outposts, guided walks and an AR application was successful in having visitors independently discover the multidimensionality of war through

engagement with primary data without clear curatorial guidance. App users can select the narratives they wish to study and the parts of the guided walk they want to explore. However, this format is still selective since the walks and outposts are curated. This basic scripting is necessary because of the vast and buried nature of conflict heritage—in the post-war years many surface features of the war were erased (Figure 5). This makes it difficult to actually read the extent of the Ypres Salient into the landscape without doing extensive research beforehand. Even with the mobile app it requires a large effort from the users to draw connections between the features you see on the digital map with the current landscape and it is only through carefully curated walks that the experience can be enhanced. A full dwelling experience divorced from specific guided walks where people freely discover the landscape of WWI is thus hampered.

In 2015 after years of preparation and visitor surveys, solutions were implemented to combat this difficulty in visualising the front. Along the frontline in Belgium 305 trees – "Memorial Trees" – were planted. The trees not only subtly mark the former frontline in the landscape but also link the three entry points of the Ypres Salient as an organic connecting tissue adding a new interpretive layer to the landscape. The mobile AR platform was also updated and connected to these trees (application was named "Ypres Salient Trees app"), providing visitors the possibility to see the trees on a contemporary map and overlay historical aerial photographs from WWI to independently study and understand the warscape. Importantly, the "Ypres Salient Trees" app provides no curated guided walks, so people can freely roam and explore the landscape by bike, foot or car and contrast the contemporary landscape with past warscapes.

For the 60 kilometre section of the front where the trees are planted, users are provided with a contemporary map, the historical aerial photographs and the location of the trees. The trees were not planted around well-known sites, but rather a study of historical aerial photographs enabled the selection of the longest stable part of the frontline. Further GIS-aided research identified hundreds of places where this front-line crossed field boundaries, roads and the public domain. 305 suitable locations were ultimately selected for planting trees to mark the front. The *Ulmus Lutece* – a modified elm which is resistant to the elm disease – was chosen for symbolic reasons. In the pre-war period this was one of the dominant species in the Ypres region and played an important role during the war, rows of trees were used to camouflage trenches and artillery emplacements. The same tree species was chosen to mark both the German and the Allied trench position as a symbol for the universal suffering, horror and trauma of WWI. From a more anthropological perspective, arboreal remembrance is a common commemorative process for war memorialisation (Dargavel, 2000) and especially WWI [1]. The memory of the war will eventually fade as the decades pass but the longer the war is over, the larger the 305 trees will become. This is similarly the case in Australia where now, over one hundred years later, avenues of honour still mark the landscape.

Most of the accessible trees have an information panel with additional information. A historical aerial photograph annotated with the frontline – also in blue and red – and the position of surrounding "Remembrance trees" provides insight into the war landscape. A war toponym (including for instance Caesar's Nose, Ravine, Hill 62, The Bluff) refers to the name these places where known as during the war and a date gives an indication of the time span of the frontline.

The app, war trees and the terrain offers visitors an insight into the physical nature of the Ypres Salient confrontation. The trees physically shape a visual concept of no-man's land. Visitors can stand on the former front lines to see and experience where the opponent's trenches were located. The "Ypres Salient Memorial Trees" application shows the location of the trees in the Ypres Salient and allows visitors to look for their location and contrast the current landscape with the historic warscape. Similar to the "Ypres Salient 1914–1918" walking tour app described above, but for a much broader area, it offers a functionality to blend a historical aerial photograph of the site with a modern orthophoto (see Plate 2 and Figure 6).
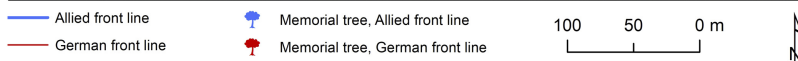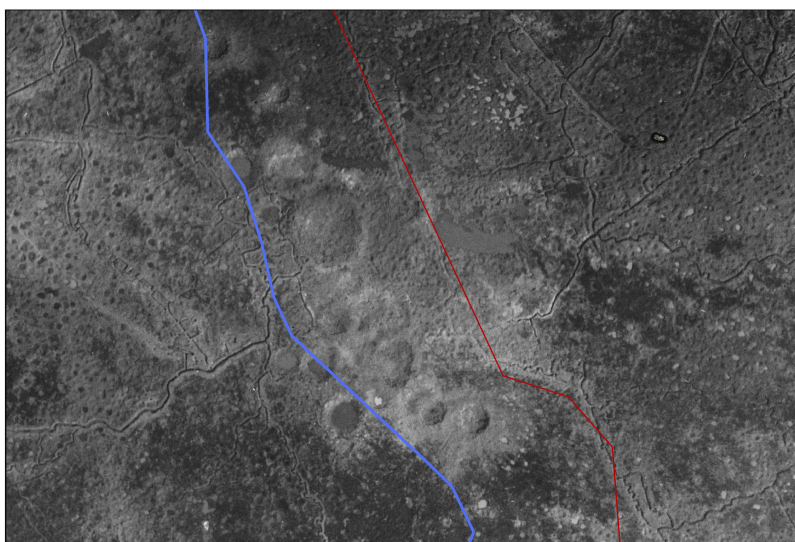
6. Comparison and user metrics

The "Ypres Salient Trees" app was initially intended as a small spinoff of the "Ypres Salient 1914–1918" guided walking app to guide visitors to interesting places in the war landscape. Without a lot of curation and preselected points of interests visitors were encouraged to independently "dwell" the landscape and discover the heritage of the war aided by the trees and archaeological information presented in the app. Despite this lack of clear curation and storytelling efforts, this app has by far received the most user engagement.

Plate 2.
Two Memorial trees on
the Allied frontline on
the Bellewaarde
Ridge (Ypres)

Although the walking app has been downloaded the most frequently, engagement with the memorial trees app is much more sustainable and has a high number of returning users (Table 1). While uses of the guided walk app had a return rated of 2, 7 on average, the trees app would on average be used 22,89 times after instalment. This reuse indicates that the app is regularly consulted by visitors to interpret the warscape buried under modern fields and buildings, but whose presence is continuously reminded by the trees.
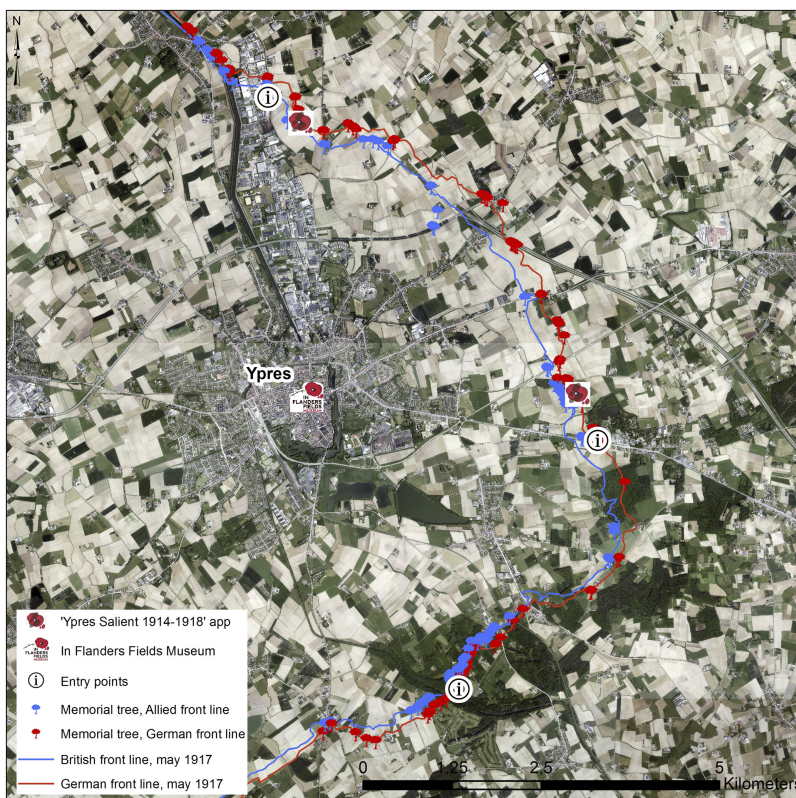
Type app	Installations	Sessions	Av. Duration session	Av. Time per install	Percentage returning users
Ypres Salient 1914–1918 "Zwaanhof" guided walk app	3.874	12.250	02:17	02:17	68.40%
Ypres Salient 1914–1918 "Hooge" guided walk app	2.048	3.789	01:29	01:57	45.90%
Ypres Salient "Trees"	2.714	62.145	01:00	07:22	95.60%

In addition, analysis of the average time spent in the walking app was around two minutes per user. The trees app would be used 368% longer (7:22). This means not only that the trees encourage users to engage more regularly with the app and discover the heritage under their feet, but also that the possibility to zoom in on archaeological data and aerial photos encourages reuse and independent exploration of archaeological heritage. The app clearly encourages people to discover the battlefield independently since it allows people to plan their visit to different trees and pick and choose different parts of the battlefield in a more flexible way than the curated scripted walks, providing people with the liberty to make their own battlefield tours. This shows a more effective way to communicate archaeological heritage to the public.

7. Conclusion

Creating an inclusive heritage engagement along the Western Front is notoriously difficult because of the selective memoryscape produced over the last 100 years. Up to the centenary (2014) a selection key sites often connected to commonwealth myths and heroic narratives defined how the WWI was presented and remembered on the ground. This article has argued for an integrated strategy for presenting modern conflict sites to counter such canonised heritage engagements. Central in the technology-driven approach presented historical aerial photographs that are used to present the landscape as the last witness and enable visitors to explore the battlefield on their own terms.

So far historical aerial photographs and GIS applications have been used as scientific tools and sources, this paper highlights how they can be used within a museum context. Different applications are presented and their strengths and weaknesses. (1) The In Flanders Earth application brings the landscape within the museum. Although it stimulates reflection over the scale and intensity of the trench warfare, it threatens to miniaturise warfare and ignore personal suffering. (2) The "Ypres Salient 1914–1918 app" bridges the gap between visitor and landscape and encourages visitors to relate to the specificity of warfare during WWI. (3) In conjunction with the memorial trees, the application was especially successful in triggering user engagement and free exploration of the warscape beyond curated walks.

We suggest that visual beacons on the ground, such as trees, markers and other forms of subtle interpretation when used in conjunction with the app enable an intimate dwelling perspective. In doing so we offer a of lens for looking at the landscape for human stories, hidden histories and personalised narratives that are directly linked to the sites that are visited. We contend that technical approaches based on AR (such as field-based reality apps) combined with visual markers of the past enable a more holistic, non-selective understanding of the experience of war. The model and interpretation strategies deployed are broadly applicable to any modern conflict following WWII. In this respect the past can be negotiated on its own terms and not through official historicised lens often determined by the panoply of state resources and official public historical discourses. Clearly, the concept of the landscape as the last witness is a powerful idea which can not only be adapted to WWI landscapes but also to a variety of other conflict spaces where personal witnesses are passing away and new ways must be explored to mediate history and heritage to a changing audience.

Note

1. Arboreal remembrance has a long tradition. In the post-war years commemorative monument trees have become an integral part of the landscape architecture. At the Canadian sites such as the Brooding Soldier and Hill 62 (both in Belgium) maple trees are incorporated in the wide avenue. The German war cemetery at Langemark was also planted with 376 oaks–the national tree of Germany– and arranged to form a *Hain des Schweigens*, a "Wood of Silence" (Höwe *et al.*, 2011). Three "peace oaks" were also planted at Sint-Juliaan as a natural monument to remember the battle of Kitchener's Wood in 1915. In Australia arboreal remembrance is a well-studied phenomenon. Over two hundred "avenues of honour" and a number of "roads of remembrance" were developed as part of local community initiatives with a strong personal identification that linked the names of servicemen and women to individual trees (Dargavel, 2000).

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Further reading

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