High-Definition Urban Narratives from Central Rome

Virtual Reconstructions of the Past and the New Caesar’s Forum Excavations

ABSTRACT Since 2017, excavations have taken place on Caesar’s Forum in Rome. The area holds archaeological evidence covering three thousand years of Rome’s prehistory and historical periods. The excavations offer wide-ranging research possibilities connected to the urban development of one of the classical world’s pivotal city centres. However, the location’s centrality also offers challenges when transforming the vast bulk and complex nature of the archaeological data into scientific publications, while also making the results accessible to the public. This article presents results from the first excavation phases within a best-practice Open Data strategy embedded into the project from its outset. The applied methods and techniques ensure that traditional, analogue scientific publications are supplemented with online access to the excavation’s raw data, high-resolution illustrations, and 3-D reconstructions obtained through laser scans and photogrammetry.

KEYWORDS Rome; urbanism; virtual reconstructions; archaeology in modern cities; longue-durée perspective; high-definition narratives; cultural heritage preservation strategies.
**Introduction**

Rome constitutes one of the most famous and continuously studied urban centres in the world with human activity reaching back several millennia in time. Since 2017, a Danish-Italian team has been exploring the hitherto unexcavated parts of the area most renowned for having housed the extensive public building project by Gaius Julius Caesar initiated in 46 BC, namely his public forum (Fig. 5.1). The space occupied by Caesar’s Forum counts as one of the most central urban excavations in the entire classical world due to its location in the heart of Rome in a period, when the city was the absolute leading power in the Mediterranean and stayed so for several centuries to come (Claridge 2010; Coarelli 2014; Erdkamp 2013). The construction of Caesar’s Forum was pivotal in changing the way in which central Rome developed in the later imperial period, and it shaped and framed political, social, and religious ideas for centuries (Raja and Rüpke 2021). However, despite the fact that the location has received most attention for being home to the first forum dedicated by one prominent individual, the area holds other extremely significant evidence of Rome’s urban development, when viewed in a longue durée perspective (Jacobsen and Raja 2018; Jacobsen and others 2020; Jacobsen and others forthcoming). Aside from its importance in the late republican and imperial periods, the location is also central to our understanding of Rome’s early developments from the Recent Bronze Age onwards and for the city’s development throughout Late Antiquity until the time of Mussolini, when the Via dell’Impero was laid out. The Caesar’s Forum area holds archaeological evidence, which covers the entire chronological span of Rome’s formation and growth, more than three thousand years from its prehistoric past until modern times (Amici 1991; Castagnoli, Morselli, and Tortorici 1982; De Santis and others 2010; Delfino 2010a; 2010b; 2013; 2014; La Rocca 2001; Meneghini 2009; 2017; Meneghini and Santangeli Valenzani 2004; 2007; Molinari and Spagnoli 1990; Morselli and Tortorici 1989; Ricci 1952; Santangeli Valenzani 2001; Vitti 2005; 2006; Maisto and Vitti 2009). Today, the space is literally occupied by Caesar’s Forum counts as one of the most central urban excavations in the entire classical world due to its location in the heart of Rome in a period, when the city was the absolute leading power in the Mediterranean and stayed so for several centuries to come (Claridge 2010; Coarelli 2014; Erdkamp 2013). The construction of Caesar’s Forum was pivotal in changing the way in which central Rome developed in the later imperial period, and it shaped and framed political, social, and religious ideas for centuries (Raja and Rüpke 2021). However, despite the fact that the location has received most attention for being home to the first forum dedicated by one prominent individual, the area holds other extremely significant evidence of Rome’s urban development, when viewed in a longue durée perspective (Jacobsen and Raja 2018; Jacobsen and others 2020; Jacobsen and others forthcoming). Aside from its importance in the late republican and imperial periods, the location is also central to our understanding of Rome’s early developments from the Recent Bronze Age onwards and for the city’s development throughout Late Antiquity until the time of Mussolini, when the Via dell’Impero was laid out. The Caesar’s Forum area holds archaeological evidence, which covers the entire chronological span of Rome’s formation and growth, more than three thousand years from its prehistoric past until modern times (Amici 1991; Castagnoli, Morselli, and Tortorici 1982; De Santis and others 2010; Delfino 2010a; 2010b; 2013; 2014; La Rocca 2001; Meneghini 2009; 2017; Meneghini and Santangeli Valenzani 2004; 2007; Molinari and Spagnoli 1990; Morselli and Tortorici 1989; Ricci 1952; Santangeli Valenzani 2001; Vitti 2005; 2006; Maisto and Vitti 2009). Today, the space is literally situated a stone’s throw from the Altare della Patria (the Victor Emmanuel II National Monument), while the Colosseum and Maxentius’s Basilica are located not far away. The location is without comparison certainly one of the most visited areas in the modern urban landscape of Rome today, a fact that brings with it several challenges when planning and conducting archaeological research (Jacobsen and others 2020).

While providing the Danish-Italian Caesar’s Forum Project with the exceptional possibility to excavate and examine all phases of Rome’s history, the area’s complex stratigraphy that includes remains accumulated continuously over millennia further underlines the pertinent archaeological challenge in excavations due to necessity to demolish the remains of cultural phases in order to proceed to the subjacent — a dilemma that is especially present in urban archaeology with its compact layering. Therefore, this article focuses on the high-definition documentation strategy implemented in the project. Focus is here particularly given to the laser scanning and photogrammetric methods implemented and the envisaged development of virtual and augmented reality of the Caesar’s Forum site through time, which will make the various cultural phases accessible for the general public in their excavated state as well as in their reconstructed states. The concept of creating a ‘digital twin’ of the excavated remains and their suggested reconstructions — i.e. a digital model with implicit storage of the excavation data, updatable as the excavation progresses — will prove useful both in relation to the project’s research aims and the processing of data and, in the long run, in relation to the dissemination of the excavation results to the general public.

**Tracing Urban History across Millennia: The Case of the Caesar’s Forum Area**

Often city centres in Mediterranean urban sites offer immense potential for examining the dynamics of urbanization processes in areas which often have been continuously inhabited through thousands of years (Woolf 2020). Archaeological stratigraphies hold archives of unleashed information deposited in place with the activities of ancient life, and they offer information on the continuing reshaping of spaces, which often were complex processes. These processes need to be disentangled carefully through the application of high-definition methods. Accordingly, the primary archaeological data is extracted on multiple levels calling for an equally multilayered high-definition approach to the fine-meshed empirical evidence and accumulated data collected during fieldwork. The aim of the new excavations on Caesar’s Forum is to significantly increase the understanding.

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7 For such approaches taken recently, see Barfod and others 2020; Bes and others 2020; Croix and others 2019; Lichtenberger and Raja 2020; Lichtenberger and others 2019; Raja and Sindbæk 2020.
of the urban development processes in Rome across three millennia through implementing a targeted analysis programme throughout the excavations and re-evaluate the results of earlier excavations in the area in close collaboration with the earlier excavators (Jacobsen and Raja 2018; Jacobsen and others forthcoming; Jacobsen and others 2020; Foro di Cesare i–ii). The excavations will work their way through more than seven metres of compact cultural layers, documenting all phases in detail. Even though the project is currently occupied with the modern phases at the site, this cross-section of the entire urban history is obtainable as excavation activities have taken place in the area of Caesar’s Forum through almost a century. Stratigraphies of the various periods have been documented, although these remain published in chronologically focused reports and articles, until now not integrated into a longue-durée narrative.8

8 For a historiographic review of the excavation activities at the site, see Sauer 2021.

The northern half of Caesar’s Forum with its temple dedicated to Venus Genetrix was first brought to light during excavations in 1931–1932 (Ricci 1932). These excavations were conducted in connection with Mussolini’s construction of Via dell’Impero, the triumphal road that runs in a straight line from Piazza Venezia to the Colosseum, today known as Via dei Fori Imperiali.9

9 On fascism’s use of the Roman past, see e.g. Arthurs 2012; Baxa 2010; Nelis 2007; Visser 1992.
medieval occupation of the site had been abandoned due to the increasing presence of water in the area (Meneghini 2017). The residential area was named after Cardinal Alessandrino, Carlo Michele Bonelli (1541–1598), who had been one of the promoters of the area’s urbanization together with the Della Valle family. The earliest phase of the neighbourhood is seen depicted on Étienne Dupérac’s map of Rome from 1577 (Fig. 5.2), which reveals a profoundly different urban space than that of today’s historical centre. On Dupérac’s map, the approximate location of Caesar’s Forum area is somewhere in between the Arch of Septimius Severus and Trajan’s Column, within the halfway stretch closest to the first-mentioned. While the Alessandrino Quarter continuously underwent rebuilding and renovations, reaching its maximum expansion in the mid-1700s as visible on Giovanni Battista Nolli’s map from 1748 (Fig. 5.3) (Meneghini 2009, 240), the neighbourhood was inhabited until the 1920s, when its about four thousand residents were evicted and, for the most part, transferred to the newly established neighbourhoods of Gordiani, Pietralata, Prenestino, S. Basilio, and Tiburtino (Cederna 1979, 192). The first phase of the new Danish-Italian excavations, conducted in 2018–2019, uncovered the remains of apartment buildings from the 1900s from the Alessandrino Quarter and the subjacent cellar and sewer structures, of which the oldest elements date back to the very birth of the Alessandrino Quarter in the second half of the sixteenth century (Jacobsen and others 2020, 46; Jacobsen and others forthcoming). Accordingly, the Alessandrino Quarter comprised a central urban space in the historical centre of Rome.
for more than three hundred years. Yet, it is today completely erased, and it has never before constituted a focal point in the various excavations conducted in the Imperial Fora area, although some excavations of the neighbourhood have been undertaken by the Sovrintendenza Capitolina ai Beni Culturali in Trajan’s Forum, Augustus’s Forum, and Nerva’s Forum in connection with the exploration of the Via Alessandrina, one of the residential area’s main roads (Bernacchio 2017; Meneghini 2000; 2016–2017, 460–62; Meneghini and Santangeli Valenzani 2010, 141–230; Molinari and Spagnoli 1990; Pocino 2008).

The cellar and sewer structures of the Alessandrino Quarter unearthed in the new excavations presumably rest upon the remains of medieval houses, the so-called *domus terrinee*, dating between the ninth and eleventh centuries (Meneghini 2017). Previous excavations at the Caesar’s Forum site (1998–2008) have demonstrated the medieval phases at the site to be characterized by the presence of orchards, vineyards, and vegetable gardens (Fig. 5.4a–b), together with the *domus terrinee* (Fig. 5.5). These one-storey houses each consisted of one single room, which often incorporated reused Roman-period architectural elements from the area, such as fragments of columns and blocks of marble, but also a range of other ancient materials such as terracotta tiles and amphora fragments. The Roman-period material is, however, reused merely as building materials inserted into the wall constructions in an unstructured manner, quite different from the processes observed in organized spoliation of Roman elements, as encountered in e.g. late antique and medieval church constructions (Meneghini and Santangeli Valenzani 2004, 45–51, 178–79; Fabricius Hansen 2015).

Below the medieval phases, the excavations will continue through the late antique, imperial, and late republican phases of the site. Originally, Caesar’s
Figure 5.4a. Reconstruction drawing of the medieval orchards and vegetable gardens in the Caesar’s Forum area. Source: Sovrintendenza Capitolina ai Beni Culturali.

Figure 5.4b. Graphical reconstruction of the medieval orchards and vegetable gardens in the Caesar’s Forum area based on the 1998–2000 excavations. Source: Sovrintendenza Capitolina ai Beni Culturali.
Forum was laid out in an area where republican elite houses had been standing, as we know from written sources, which convey to us that the Roman writer and politician Marcus Tullius Cicero and Gaius Oppius had bought the land from private owners at a high cost (Cic., *Att.*, iv.17; Suet., *Iul.*, 26; Raja and Rüpke 2021). The building project was one of extreme prestige. The first of its kind in central Rome right next to the Roman Forum, the public space of the Roman people. In addition, archaeological remains in the form of a pit with domestic pottery and tiles dating to the middle and late republican periods further lend support to the literary sources (Bertoldi and Ceci 2013, 45–47). Today, two-thirds of Caesar’s Forum has been uncovered, of which the major parts were excavated in the 1930–1932 excavations and further areas in the 1998–2008 excavations, which were conducted in relation with the Great Jubilee as part of a joint project between the Ministry of Cultural Heritage, the Sovrintendenza Speciale per i Beni Archeologici di Roma, and the Sovrintendenza ai Beni Culturali del Comune di Roma. Between 1998 and 2000, the excavations unearthed an area of 3500 m² in the southern half of Caesar’s Forum (La Rocca 2001; Meneghini 2009). While Cicero and Oppius had bought the land in 56 BC, the construction of Caesar’s Forum began in 54 BC with a grand-scale levelling of the area, which was otherwise sloping up towards the Capitoline Hill. By evening out a difference in height of three to four metres over fifty metres in the northern end of the area, a level forum square was created (Fig. 5.6). The Caesar’s Forum complex with the temple to Venus Genetrix, the mythical ancestress of gens Julia (see Figure 5.6. Plan of Caesar’s Forum. The black structures show the forum as it was, when Octavian finished its construction, while the red structures show the original plan. The light brown marking shows the area which was levelled at the forum’s construction in 54 BC. Illustration by Sine Grove Saxkjær.

Figure 5.5. The remains of the domus terrinee on Caesar’s Forum. Photo by the Caesar’s Forum Project/Giovanni Murro.
e.g. Farney 2013; Saxkjær 2021; Smith 2010; Weinstock 1971) in one end of the rectangular square (approx. 115 × 30 m), which was otherwise surrounded by colonnades on the remaining three sides, became a benchmark for the displays of imperial power encountered in the Imperial Fora in the centuries to follow, such as seen in Augustus’s Forum, Nerva’s Forum, and Trajan’s Forum as well as in the Templum Pacis complex by Vespasian (Jacobsen and Raja 2018). However, Caesar did not live to see his forum finished. Although Caesar inaugurated the temple in 46 BC, the forum complex was not completed until after his death in 44 BC. Its construction was finalized by Octavian (later to become the first Roman emperor with the name Augustus), Caesar’s adoptive son, who also enlarged the square’s original layout towards the south (Delfino 2010a, 335).

Underneath the levels of Caesar’s Forum, the excavations are expected to uncover the pre-republican settlement contexts on the site in addition to potential scattered remains of the republican residential contexts. In the 2005–2008 excavation campaigns, archaic settlement remains were uncovered in the form of two stone-built structures and several wells together with tiles and domestic pottery (Delfino 2014, 64–135; 2010b; Sauer forthcoming). The oldest archaic phase dates back to the beginning of the sixth century BC, while the structures were rebuilt several times in the following centuries until the late republican phase, predating the construction of Caesar’s Forum (Delfino 2014, 124).

The earliest traces of human activities in the Caesar’s Forum area consists of sporadic finds of pottery together with post holes and a series of wheel-tracks, datable between the thirteenth and eleventh centuries BC (De Santis and others 2010, 261–62; Meneghini 2009, 12). The Bronze Age wheel-tracks predate a prehistoric burial ground, which was established in the area in the eleventh century BC. A total of twelve tombs have been excavated in the Caesar’s Forum area. Ten tombs have been dated to the eleventh and tenth centuries BC: six cremation tombs, of which five have been ascribed to adult males and one to a child, together with four inhumations tombs, of which two are identified as female (De Santis and others 2010, 263) (Fig. 5.7). These tombs are believed to have been part of a larger necropolis area situated in the valley between the Capitoline and Quirinal Hills, as indicated by additional finds of contemporary burials at the Augustus’s Forum site (Meneghini 2009, 12). The remaining two tombs date to the mid-eighth and last half of the eighth century BC (De Santis and others 2010, 278). Both are infant burials equipped with rich sets of funerary goods, situated inside a hut structure, i.e. examples of the well-known Latial practice of suggrundaria (Fulminante 2018, 198–99). This hut structure had been erected on top of the aforementioned burial ground, indicating that it had gone out of use, and the area transformed into a residential area sometime during the late ninth or early eighth century BC (Meneghini 2009, 19).

Due to the location in the south-eastern part of Caesar’s Forum, which was left untouched by the large-scale levelling of the area (cf. Fig. 5.6) in connection with its construction, the excavations of the Caesar’s Forum Project are likely to encounter all of the cultural phases described above, and the project therefore constitutes a unique opportunity to reassess Rome’s urban and pre-urban history from its earliest phases until today in a longue-durée perspective. What is more, through the carefully targeted analysis of specific phases of the stratigraphy, the project aims at refining its various phases as well as estab-
lishing the changing urban networks that influenced and formed the city’s formation and development.

**Challenges and Possibilities in Urban Archaeology: High-Definition Documentation Strategies and their Implications**

A pivotal aim of the excavations is to document all of the site’s phases in the most comprehensive shape possible in order to convey as much data about the various phases as possible to researchers and the general public. Contemporary with the excavations a subproject has been launched in which a comprehensive 3-D scan of Caesar’s Forum is being undertaken. Furthermore, a topographical map is being created, which is aligned with the mapping of the rest of the Imperial Fora region. The 3-D scans are produced through the use of drones. The two 3-D models are being produced in CAD in 1:50: one shows the present-day street level and the other the original late republican-period forum level. Already existing digital and analogue excavation data and topographical data from the Archivio dell’Ufficio dei Fori Imperiali is also being incorporated into these models.

The Caesar’s Forum excavation will work its way through the aforementioned seven metres of compact cultural layers including more than three thousand years of urban history, eradicating the various phases in the excavation proceeds, but with today’s state-of-the-art technological documentation methods, the project’s documentation strategy aims at securing all data from each cultural phase, enabling the possibility of continuously revisiting and reworking it (Roosevelt and others 2015). In addition, the raw data of the project will be made available in online repositories. In this way, interested researchers can not only find and access the raw data, but also reuse it in their own research, since it will be made available in interoperable ways, e.g. in downloadable forms of various kinds depending on the datasets.

Within the Caesar’s Forum Project, laser scanning and photogrammetry constitute core elements in the overall documentation strategy in order to create an as detailed and reproducible documentation record as possible. Both methods are easily integrated in the creation of models and in the archaeological documentation, and the combination of the two techniques allows for the creation of a precise diachronic and typological mapping of the structures that will be demolished during the excavations. What is more, their precision and rapid data collection makes the methods an obvious choice, not least for urban archaeology where the surrounding environment with its required safety measures — the Caesar’s Forum excavations being situated in one of Rome’s most visited areas — demands a high pace for the excavation activities. In general, the techniques for visually documenting archaeological excavations have rapidly evolved over the last twenty years. Today, such documentation methods have often de facto replaced the traditional documentation and survey systems, which gradually developed and improved from the sixteenth century onwards. This change has resulted in a general fusion between what was traditionally the work of land surveyors on the one hand and archaeologists on the other hand, as technological advances have made the required knowhow more readily accessible. While the new methods come with a noted change of pace in documentation techniques, which has given way to hitherto unprecedented perspectives that lead to an enrichment from a purely technical-archaeological point of view as well as with respect to the future dissemination possibilities of the same to the general public, they also present a risk of a decrease in deep knowledge and specialized skills (Giuliani 2008, 9–12). The new indirect survey technologies can potentially cause an abstraction from the context and the cognitive processing of the same, as it is now in fact possible to create a complete laser-scanned survey of a given site almost without touching the archaeological remains. Still, with careful application of these methods and the specialists involved, the benefits outweigh the potential pitfalls.

Accordingly, the first step in documenting contexts of structures excavated within the Caesar’s Forum Project involves the use of the laser scanner and close-range and aerial photogrammetry, methods that are increasingly common in archaeological excavations. Starting with the first of the mentioned instruments, its main purpose concerns purely technical documentation. The scan performed by the instrument produces a three-dimensional point cloud containing millions of points reproducing the artefact. Each measured point contains three-dimensional (x, y, z) and colorimetric (RGB) spatial information. The laser scanner has multiple advantages. First of all, it allows for a complete three-dimensional acquisition of precise geometric and dimensional data. Another important operational aspect is the speed in data acqui-

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10 For the project’s Open Data strategy and adherence to the FAIR principles (Wilkinson and others 2016), see Jacobsen and others 2020, 36–58.

11 On general characteristics and critical aspects of these techniques, see Gonizzi Barsanti, Remondino, and Visintini 2013.
Figure 5.8. Laser-scan models of the excavation area. Models by the Caesar's Forum Project/Giovanni Murro.
Position (also performing the pre-alignment of scans in the field through the use of specific software such as the one found on all Leica Cyclone FIELD) and the possibility of performing scans even completely in the dark, as was the case in connection with the cellars below the Alessandrino Quarter and thus the initial excavation area of Caesar’s Forum (close to the no longer existing Via Cremona), where very positive tests were carried out this way. In the case of a construction in several levels, such as the one under consideration with a first floor and cellar structures, the laser survey also constitutes a fundamental tool in the pre-excavation preparation phase. The point cloud produced can be imported into the most common CAD and BIM software to perform a series of complex operations in a short time, such as volumetric calculations, extrapolation of plans, sections, and elevations (Fig. 5.8). This has proven essential in the planning of the demolition of the Alessandrino cellars and sewers, which are required for the excavations to reach subjacent phases.

The photogrammetric approach constitutes another core element in the project’s documentation strategy. This technique allows the acquisition of metric data from an object starting from a series of photographs. Using software (the best known is Metashape by Agisoft) the frames are first aligned, for which the spatial positions are recognized. If the used camera is not equipped with GPS, the preliminary orientation in the defined common reference system will be required. The photogrammetry, although being slower than the laser scanner in the data acquisition phase and having a lower precision (Barsanti and others 2014, 141–58), has some important strengths: it is in fact much cheaper, with the possibility of obtaining data even using non-professional photographic equipment; the process of learning the basic technique is faster and does not necessarily include previous notions in the field of three-dimensional modelling; it produces textures of much higher quality than those of a laser scanner, ultimately proving to be a more flexible method also in the process of processing the data and the final products obtainable. This was also the case with the test that was carried out in the cellars below the excavation area (Fig. 5.9). The survey, obtained by artifi-
cially lighting all the detected environments, showed coverage and geometric precision inferior to the laser scanner, but with an extremely well-defined surface texturing. The potential, which marks the transition from a ‘flat’ to a volumetric documentation, also concerns didactic aspects with the possibility of precisely recreating, revisiting, and questioning urban contexts destined irremediably to disappear within a few years. As for the laser scanner, the three-dimensional products obtained through photogrammetry can serve as a basis for creating virtual-reality models and experiences, importing the meshes obtained in cross-platform graphics engines such as Unity and Unreal Engine.

**Visualizing the Past in Modern Urban Contexts: Virtual Reconstructions of Urban Spaces for Research and the General Public**

The above-mentioned technological methodologies are not only of pivotal importance in relation to research. Within the field of disseminating knowledge to the general public, advanced technologies such as multimedia technologies, virtual reality (VR) and augmented reality (AR) have become key tools through which to communicate archaeological sites. This goes hand in hand with tourism promotion, as the technologies make the archaeological remains comprehensible in their reconstructed shape which enhance the visitor’s experience profoundly (Iacovino, Tommaso De Paolis, and Ndou 2020, 4; Ferdani and others 2019). It furthermore broadens the possibilities of making otherwise complex archaeological remains interesting for the general public and not only for experts: even ancient structures with only a few elements preserved for posterity can now with
multimedia technologies, virtual or augmented reality be disentangled for a wide audience.

In Rome, the archaeological authorities have been frontrunners in applying such new advanced technologies. An early example on the use of multimedia technologies in an on-site musealization is Le Domus Romane di Palazzo Valentini, situated immediately adjacent to Trajan’s Forum. Following a profound renovation of the sixteenth-century Palazzo Valentini, archaeological excavations in 2005–2009 uncovered a series of building phases dating between the first and fifth centuries AD beneath the palazzo, most importantly two rich domus of mid- and late imperial age, refurbished between the end of the third and mid-fourth centuries AD, together with a thermal complex. The exhibition was inaugurated in 2010, allowing for its audience to view the archaeological remains through about 200 m² of plexiglass floorings, offering virtual reconstructions and explanations of the remains with the use of lighting effects (Baldassarri 2017; Del Signore 2016; Napoli and Baldassari 2015) (Fig. 5.10). However, during the last decade the technology has rapidly advanced. With virtual reality it is now possible to create a simulated environment, while augmented reality makes it possible to integrate virtual objects into real environments in real time, which makes these technologies a perfect match for archaeological sites. One of the pioneering projects in Rome integrating these technologies was L’Ara com’era: Un racconto in realtà aumentata e virtuale at Museo dell’Ara Pacis, running from 2016 to 2019. The project combined 3-D reconstructions and computer graphics, which made it possible to visit the ancient Campus Martius in a 360° environment and see a Roman sacrifice in virtual reality, while the VR headsets worn by visitors in the museum further made it possible to admire Ara Pacis in all its original colours.14 Since 2017, it has been possible to visit the archaeological restoration site of Domus Aurea, where the innovative use of multimedia together with the implementation of both virtual and augmented reality makes it possible for visitors to experience the virtual reconstruction of Emperor Nero’s golden palace. Especially the high-definition installation in augmented reality in the so-called Golden Vault Room creates a time-travel experience back to the palace’s rediscovery in the Renaissance and back to its original splendour (Borghini, Scoccianti, and D’Alessio 2019) (Fig. 5.11). The Terme di Caracalla inaugurated their augment-

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14 See the Ara Pacis website <http://www.arapacis.it/it/mostr ed_eventi/eventi/l_ara_com_era> [accessed 4 November 2020].
ed-reality project the same year as Domus Aurea, making it the first archaeological site in Rome to be visitable in its entirety in a 3-D reconstruction with the use of portable VR headsets (Cochetti and others 2018). Lastly, it is worth mentioning the Circus Maximus, where a similar use of the VR and AR technologies enables the site to be seen through all its historic phases, the project being launched in 2019 (Buonfiglio and others 2018).

The above examples demonstrate the gradual development of multimedia techniques as well as the increasing competencies to incorporate them as part of the musealization of archaeological sites during the last decade. What is more, the examples further demonstrate the aim to make a virtual reconstruction of the Roman phases available for the general public to be a reoccurring element across these museological projects. In general, the Roman — and not least the imperial — phase of Rome’s urban history often constitutes the pivotal focus in excavations as well as in the musealization of archaeological sites. As described in the above, the Caesar’s Forum Project aims at examining and broadening our current understanding of all phases within the city’s urban development from its earliest Bronze Age phases until the historical remains from the beginning of last century. This goes for the excavation and research strategy of the project as well as for the later dissemination of these to the general public. Accordingly, for the first time in the historical centre of Rome, augmented and virtual reality will be developed for the Caesar’s Forum area so that it will be possible to visit all cultural phases — preserved as well as demolished — of the site as well as their reconstructions. This duality will give the audience insights into both the different excavation phases as well as the reconstructions for which they formed the basis. It will create the possibility of a three thousand-years’ time travel as well as a unique account of the levels and phases in a modern urban excavation.

A preliminary documentation will be carried out in relation to the areas subjected to demolition and excavation, which aims at creating a virtual tour, through a procedure divided into several phases, starting with the acquisition of data through spherical photos taken with a 360° camera and ending with the creation of a code file to be uploaded to the web. In this case, the dissemination possibilities are immediate and within the reach of a global audience, without limitations on computer literacy. The digital detection technology is ultimately functional to the data storage of urban monumental contexts destined to disappear, while at the same time it can be converted into an instrument for the enhancement and use of architectural heritage through the use of 3-D printing. The latter technology has found development in cultural heritage especially in the museum field (Francescangeli and Monno 2010; Revello Lami 2017), but it can also find an interesting application in the reproduction of monuments and buildings. What is more, the creation of such a virtual archaeological path — a ‘digital twin’ — which exists parallel to the actual excavations, will overall increase the level of accessible information, just as it can overcome geographical barriers as it can be accessed from anywhere in the world — this not only being in terms of the general public, but also in relation to ongoing research activities. As shared virtual archaeology, such documentation must foremost act as ‘un sistema di comunicazione e di validazione delle fasi di ricerca bottom-up e top-down, una silloge di dati e prove dinamici altrimenti non desumibili se non con logiche di feedback’ (‘a system of communication and validation of research phases bottom-up and top-down, a collection of data and dynamic tests otherwise not deducible except with feedback logic’) (Forte 2007, 9). Due to this methodological premise, the chosen techniques range from ‘simple’ methods, such as 360° virtual spherical photos of the excavation’s various phases, to the creation of more structured environments, measurable and fully navigable three-dimensional models, which furthermore can be explored and printed in scale. In the previous twenty years, there has been both a quantitative and qualitative increase in projects related to the digitization of cultural heritage, each with their own specific focus on aspects, such as the architectural aspects within the Rome Reborn Project (see Frischer and others 2006, 163–82) or the cartographic-urbanistic aspects within the Descriptio Romae Project (<www.storiadellacitta.it/2017/11/04/webgis-descriptio-romae> [accessed 4 November 2020]). While following the path of these previous projects, the Caesar’s Forum Project seeks to add new and improved elements, especially in relation to the continuous dissemination of results related to the different cultural phases of the ongoing excavations of the Caesar’s Forum Project. Thus, the excavation is divided into two separate entities: the physical one and the immaterial digital twin. The latter will be configured as a container of interrelated contextual elements, consisting of images and interactive information. Compared to its physical counterpart, the digital twin has the possibility of becoming not only a container of information elements located beyond the excavation context, but it can also provide a direct link to its user. As emphasized elsewhere (Ceraudo and Murro 2016, 71), this correlation cannot be separated from one
central prerogative: the intelligibility of the ancient remains. A common mistake is in fact to believe that an archaeological context can easily be understood by everyone through the use of technical terminology or technical plans and images that in fact require a certain level of prior knowledge in order to be understood. The described digital tools are aimed not only at describing or conveying the emerging data (i.e. the archaeological finds and remains), but also at communicating, strictly scientific, reconstruction hypotheses at different levels, both chronological and purely dimensional from an urban scale — e.g. building complexes — to those of smaller dimensions — e.g. a specific architectural fragment, sculpture piece, etc. Compared to previous projects, the project aims to improve the relationship between context and user by reducing the ‘gap’ between a peer and public audience that too often has characterized the panorama of cultural-heritage enhancement.15 This further entails that in addition to the above-mentioned public dissemination purposes, an additional aim is to collect and critically organize the data on the overall urban planning of the site in its various phases as well as the specific construction data for the individual building structures. Within this context, the digital-twin concept is also useful. While initially having been developed in the engineering field (Grieves and Vickers 2016), the digital twin in archaeology demonstrates an accurate representation of what has been excavated. Here, the production of a digital twin will prove pivotal. First of all, in the context of an archaeological excavation, one twin is destined to disappear, leaving the other with the task of representing the entirety of the context. Secondly, the digital twin can become a rich reservoir of information, which can be integrated with other data management methodologies.16

A Virtual High-Definition Journey through Rome’s Urban History

In relation to the virtual and augmented reality planned by the Caesar’s Forum Project, the site’s various architectural remains can be grouped in three broad chronologically separated categories based on their differ-

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15 For the relationship between public and cultural heritage, see Smith and Iversen 2012.

16 For the association between digital twin and Historic Building Information Modelling, HBIM, see Jouan and Hallot 2019.
ent characteristics in regards to conservation and/or demolition as well as actual physical accessibility. The three categories are constituted by the architectural remains from Caesar’s Forum (which will be preserved in their entirety as is the case with previous unearthed remains from this phase); the pre-Roman phases below Caesar’s Forum, consisting of the archaic settlement remains as well as the prehistoric necropolis area (which, due to their subjacent placement, are by default inaccessible); and the post-Roman phases above Caesar’s Forum, that is, the remains from medieval, Renaissance, and historical times (which will be demolished during the excavations).

Starting with the republican and imperial phases, Caesar’s Forum is already today for a substantial part visible to visitors. Caesar’s Forum is the only forum which is uncovered in its full length. The current excavations will bring an additional important part of Caesar’s Forum to light, namely to the western colonnade towards Augustus’s, and hereby make the forum visible in its full width. It is furthermore realistic that new marble elements pertaining to the sculptural decoration programme of the forum will be found (Fig. 5.12). The Roman architectural remains have already partly been documented through laser scanner and photogrammetry in order to furnish a virtual visit to Caesar’s Forum. A 3-D reconstruction will transform the physical architectural remains into a comprehensive visible product through which Caesar’s Forum and its architectural sculpture can be virtually experienced as it would have been in Antiquity. A crucial element in creating these 3-D reconstructions is to gain the widest possible understanding of the aesthetic expression of the
forum during the Roman period, both in regards to the marble architecture as well as the sculptural programme of Caesar’s Forum. This approach is already implemented in the project’s research on excavated parts of the Alessandrino Quarter, where all excavated elements including tiles, floorings, and architectural pieces (Figs 5.13–5.14) are being incorporated in the 3-D reconstructions, and the same approach will be applied to the medieval building remains. In regards to Caesar’s Forum itself, the project is launching a systematic investigation in the ancient polychromy of sculpture and architectural elements which will appear in the excavation. Investigations will apply non-invasive analyses, such as microscope studies and Visible Induced Luminescence (VIL), together with ultraviolet fluorescence (UVF). Furthermore, X-ray fluorescence (XRF) will be used to identify elements, and it is particularly suited to the analysis of inorganic pigments and glazes. It is — to the best of our knowledge — the first time that research on polychromy on Roman sculpture has been systematically incorporated in an ongoing field project and the potential research output is notable. The research field has so far been centred around analyses of sculpture in large public collections, whereas material from contemporary excavations has only rarely been the object of investigations despite having a larger research potential (Brinkmann and Brinkmann 2020, 29–48; Østergaard 2017). Except for the often-lacking basic information about provenance and find circumstances, museum pieces generally display less well-preserved colour traces due to periodic cleaning and general decay caused by continuous light exposure. Newly excavated sculpture and architectural elements, on the other hand, have not undergone a cleaning and restoration process, providing ideal conditions for investigations.

In relation to the pre-Roman remains below Caesar’s Forum, their accessibility includes other considerations. Managers of urban archaeological sites are often facing the dilemma of to what extent accessibility should be permanently secured to all parts of the site or whether these areas should be recovered or partly or fully fenced off. The issue is well known from catacombs in major cities throughout Europe and from large open archaeological areas with complex architectural layouts such as Pompeii and the Roman Forum. Prioritizing public accessibility is dependent on variables such as visitor security, actual possibility for physical access to narrow spaces, and state of conservation of the specific archaeological site. On Caesar’s Forum, deep wells from the archaic period together with the aforementioned rock-cut graves from the prehistoric necropolis area present a challenge when it comes to accessibility. Previous excavations have brought to light a number of wells below the central square of Caesar’s Forum, the deepest of which reaches a depth of c. 3 m (Delfino 2010b, 287). The wells are important testimonies of settlement patterns prior to the construction of Caesar’s Forum, and they have produced vital information on the relative chronology of the deposited archaeological material within them. Excavations conducted in 1999–2000, 2005–2006, and in 2008 unearthed a total of thirteen graves (De Santis and others 2010, 259), located in relative proximity to each other below the south-western part of the forum square in an area directly bordering the excavation field of the Danish-Italian project. Based on the associated grave goods, ten of the graves can be dated to the period between the eleventh and tenth centuries BC, while the remaining date to the subsequent period. The grave goods from a limited selection of graves can be viewed in the display of the Museo
Nazionale Romano, while the remaining material is kept in storeroom facilities. Today, the wells on Caesar’s Forum are covered off for security reasons, while the graves have been backfilled. Although the current excavation is yet to reach the pre-Roman levels it is fair to assume that additional wells and, not least, additional graves will surface within the new excavations. This provides the possibility of combining previous and future grave structures in a single virtual display/platform, which offers a precise 3-D prospect of the grave interior. In funerary archaeology, grave goods obviously play a role as an integrated part of the archaeological reading of depositional rites and the conception of the after-life. Grave goods and their positioning within the grave will be documented through photogrammetry in the current excavation. This will not be possible for grave goods from previous excavations, but the individual objects from each grave and their position recorded in the analogue excavation documentation will be sought, integrated, and combined with 3-D displays of the grave goods. The described virtual platform may potentially be expanded to cover all Iron Age graves from the Roman Forum and the Imperial Fora, offering a comprehensive detailed insight into the prehistoric funerary use of the area between the Capitoline and Esquiline Hills, covering both grave distribution and developments in grave rites.

With the last of the three categories — that is, the medieval, Renaissance, and historical architectural remains — virtual models will be made of both the excavated remains from the various phases as well as their reconstructions. Starting with the remains of the Alessandrino Quarter, we are here dealing with a historical period of Rome, as the neighbourhood was demolished in connection with the construction of Mussolini’s Via dell’Impero (today Via dei Fori Imperiali). The last houses of the Alessandrino Quarter were demolished in 1933, while Via dell’Impero was inaugurated by Mussolini on 28 October 1932 (Meneghini 2009, 241). As written in the above, the latest renovations of the buildings took place in the beginning of last century, while the oldest parts of the subjacent cellar and sewer structures date back to the neighbourhood’s establishment in the second half of the sixteenth century. All of these remains will be completely demolished in order to reach the cultural phases below, which makes the virtual reconstructions of the structures the only way to preserve and showcase this historical phase of Rome’s historical centre for the general public. It will be the first 3-D reconstruction of the Alessandrino Quarter, giving visitors to the site an idea of Rome’s centre prior to the 1930s. The medieval structures, on the other hand, will be partly preserved for posterity, as part of the previously excavated domus terrinee (Meneghini and Santangeli Valenzani 2004, 45–51, 178–79) are visible today. The expropriation of the Alessandrino Quarter and the following relocation of its inhabitants was a crucial event in the recent history of Rome, and the following demolition of houses caused fundamental and permanent changes to the urban layout of central Rome. The described documentation of the remains brought to light during the recent excavations offers the last possibility to enhance the understanding of the cultural significance of the Alessandrino Quarter through its time as a central urban neighbourhood and until its destruction under Mussolini. Up to now, the main new insights into the history of the Alessandrino Quarter have been obtained through the historical cartography and plans together with the brogliardi and a limited number of contemporary street photos (Jacobsen and others 2020). The Caesar’s Forum Project offers a direct expansion of the source corpus starting from a micro high-definition narrative level, including, among other things and as described, mortar composition, masonry type, and floorings. The project moves into the macro level, still through high-definition documentation, with the new visualization of the Alessandrino Quarter through 3-D reconstructions.

Conclusion

Archaeological projects taking place in modern urban centres are confronted with a particular set of challenges, which arise from the surrounding landscape being in use on a variety of levels. This complex mosaic of challenges ranges from addressing the diversity of the archaeological deposits and structural remains to modern infrastructural issues, which are of constant concern. What is more, often there is time pressure to finalize excavations, and these are usually considered emergency excavations, since the central urban space needs to go back to being usable within the context of a living modern city. While archaeological methods have improved immensely over the last decades, and archaeological units working in city centres are immensely professional and in command of techniques and methods which allow us to document and preserve much data from such urban excavations, there is still a pressing need for making such data available fast to both the scholarly community and the general public. Notably, in respect to the former, a clear and easily implementable data-sharing strategy is imperative in ensuring the research flow in an international and interdisci-
plinary research project such as the Danish-Italian excavations on Caesar’s Forum. We have here shown in which ways we attempt to make such data available through the approach taken within the Caesar’s Forum Project, coordinating digital documentation with the physical documentation strategy and bringing these two kinds of documentation strategies into close communication with each other in order to optimize the understanding of the dense and complex urban stratigraphies encountered in a city like Rome.

Abbreviations

Cic., Att.: Cicero, Epistulae ad Atticum.
Suet., Iul.: Suetonius, Divus Iulius.

Works Cited


