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(Eds.)

QUANTITATIVE STUDIES AND PRODUCTION COST OF ROMAN PUBLIC CONSTRUCTION

ESTUDIOS CUANTITATIVOS Y COSTE DE PRODUCCIÓN DE LOS EDIFICIOS PÚBLICOS ROMANOS

ÉTUDES QUANTITATIVES ET COÛTS DE LA PRODUCTION DES ÉDIFICES PUBLICS ROMAINS

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Prologue

La quantificazione della forza lavoro e dei costi nell'edilizia è un campo relativamente nuovo, ormai definito come una branca dell'archeologia dell'architettura: dopo i lavori pioneristici del '900, il libro sulle terme di Caracalla a Roma di Janet De Laine del 1997, ormai classico, ha indicato una via, che dopo venti anni risulta ben tracciata e seguita da molti. Questa raccolta di saggi, che spaziano dal IV secolo a.C. al tardo antico, offre un panorama sintetico ed efficace di questo tipo di approccio; si tratta per lo più di casi studio, orientati su edifici o contesti specifici, ma non mancano i tentativi di sintesi di periodo che intendono profittare dei dati raccolti in questi anni. Alcune tematiche sono qui elaborate con maggiore respiro: diversi casi prendono in esame la costruzione di mura, anche in connessione con gli elementi di reimpiego. Il comune denominatore è il metodo, basato sulla ricostruzione delle ore di lavoro in base al modello del manuale ottocentesco di Pegoretti, come indicato da Janet De Laine. In tal modo si ottiene una certa uniformità nei calcoli, che consente di metterli a confronto e di tirare conclusioni, anche se nel futuro occorrerà estendere maggiormente la ricerca e cercare di ottenere costanti per regioni e periodi, tali da permettere conclusioni articolate. È comunque chiaro che il manuale di Pegoretti non può spiegare tutti i casi con cui si confronta l'esperienza archeologica, e a volte occorrono modelli alternativi da costruire con l'aiuto dell'esperienza o di altre fonti. Certo, la ricostruzione della *chaîne opératoire* nell'edilizia antica, premessa indispensabile per il calcolo quantitativo del lavoro, è l'operazione più complessa, perché va adattata ai singoli casi e ai molteplici problemi derivanti dalla disponibilità dei materiali e dal loro trasporto. Il problema del rapporto coi costi è certo il più complesso da affrontare: come per la quantificazione del lavoro e dei materiali, occorre sempre premettere che si tratta di proporre un "modello", come in molti ambiti scientifici (dalla fisica alla medicina alle scienze naturali): pur non esaurendo la complessità del reale, il modello è una prassi conoscitiva che aiuta a comprendere meglio, in questo caso, l'economia delle costruzioni. Elaborare un modello dei costi consente dunque di comprendere meglio il fenomeno dell'architettura monumentale antica sul versante economico-finanziario, compreso il ruolo del committente nel progetto, che doveva contare su una previsione anche grossolana dell'esborso previsto. Questa branca di studi è comunque ancora giovane, in fase di sperimentazione: non mancano le premesse che condurranno verso una sempre maggiore omogeneità nella definizione dei metodi e delle pratiche di quantificazione. In ogni caso, le stime elaborate si basano sempre su dati di fatto e su ragionamenti pratici, tesi a capire meglio la logistica e le questioni organizzative del cantiere antico che determinavano le operazioni da compiere prima, quelle da compiere dopo, e quelle possibili in simultanea: uno sforzo di ricostruzione teorica che è tanto più impegnativo, quanto più complessi sono gli edifici coinvolti, soprattutto gli edifici teatrali. Già solo per questi motivi, i saggi qui raccolti costituiscono un notevole richiamo per tutti gli studiosi dell'antichità.

Paolo Barresi

Remerciements

Cet ouvrage est le fruit de rencontres entre différentes générations d'archéologues, allant des plus confirmés au doctorant, mais tous ont un intérêt commun celui d'évaluer le temps de travail et les coûts de production.

Ce sont deux réunions qui ont permis la naissance de ce livre, la première a été pour moi la plus déterminante avec un workshop intitulé *Aspectos económicos de la construcción de edificios en el Occidente romano* le 9 mai 2017 au sein de la **Escuela Española de Historia y Arqueología en Roma – CSIC**. Je profite de cet espace pour réitérer ma gratitude envers l'EEHAR qui avait démontré un intérêt certain pour ce sujet. Il n'y avait donc pas de centre plus prestigieux pour partager nos investigations que le centre de l'Empire romain. Cette rencontre n'aurait pu se concrétiser sans le soutien inconditionnel du Prof. Dr. Carlos Márquez (Universidad de Córdoba), directeur du groupe de recherche **Antiguas Ciudades de Andalucía : desde la investigación a la rentabilización social**. Mes mots resteront toujours cours pour lui exprimer ma reconnaissance tout au long de ces années.

Une deuxième rencontre organisée du *Theorical Roman Archaeology Conference XXVIII* **(University of Edinburgh)** est venue renforcer ce projet. Je suis extrêment reconaissant envers chaque participant de ces deux évènements pour avoir répondu à mes appels. Leur engagement a permis de constituer une petite communauté où sont apparus entre chacun des liens professionnels et amicaux.

Je terminerai simplement en remerciant chaleureusement tous les auteurs présents dans cet ouvrage. C'est avec fierté que j'exprime le fait d'avoir travaillé avec eux pour offrir à l'investigation un ouvrage dédié uniquement aux études quantitatives sur les édifices publics romains depuis l'époque républicaine jusqu'à l'Antiquité tardive. Il faut espérer que tous ensemble nous ayons accomplit un nouveau pas dans ce domaine de recherche.

Christopher Courault

Introducción a los estudios cuantitativos sobre el tiempo y coste de la construcción

Christopher Courault
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El presente libro es el resultado de dos años de encuentros y eventos que hemos organizado. El primero concierne un workshop que tuvo lugar en la Escuela Española de Historia y Arqueología en Roma (9 de mayo de 2017) titulado *Aspectos económicos de la construcción de edificios públicos en el Occidente romano*; mientras que el segundo evento responde a la organización de una sesión *Quantifying Public Construction: Figure Labour, Territory Exploitation and Production Cost* durante el Roman Archaeology Conference XIII and Theorical Roman Archaeology Conference XXVIII en la Universidad de Edimburgo. Esa obra ha sido enriquecida por contribuciones de otros autores agrupando tanto a investigadores confirmados como una nueva generación. Este libro consiste en ofrecer una recopilación de recientes trabajos dedicados únicamente a los estudios cuantitativos y costes de construcción.

Entre ambas reuniones y la publicación de este libro, tuvo lugar el XIX International Congress of Classical Archaeology (Cologne/Bonn, 22-26 May 2018) en el que hubo un foco especial de tres sesiones sobre los estudios cuantitativos y economía de la construcción, así como la publicación de los libros *Costi, Tempi e metri cubi. Quantificare in architettura*[1], y *Constructing monuments, perceiving monumentality and the economics of building*[2]. Todo ello no hace más que demostrar el creciente interés durante estos últimos

1 Brogiolo, Camporeale, Chavarría Arnau 2017.
2 Brysbaert *et alii* 2018.

años hacia esta clase de investigación donde la Prof. Janet DeLaine ha sido la precursora abriendo un nuevo campo de investigación al interesarse sobre los costes[3].

Desde una perspectiva general, existe una tradición en aplicar la metodología de cuantificación de la economía antigua[4], lo mismo que se encuentra en investigaciones dedicadas al mundo medieval islámico[5] y cristiano[6]. De hecho, los manuales del siglo XIX que sirven de apoyo a las actuales investigaciones son estudios para explicar el coste de la construcción en época moderna[7]. En otras palabras, frente a la dinámica actual, tanto los estudios cuantitativos y los costes de la construcción como metodología se van convirtiendo en un campo à part entier de la arqueología. A modo de ejemplo, se le asocian otras metodologías de índole química para poner en relieve las composiciones geológicas de un edificio con el objetivo de relacionarlo con una o varias canteras, y aquilatar de modo más concreto el volumen del material empleado[8].

De modo esquemático, y basándose en Pegoretti el proceso de construcción se divide en unas tres etapas para el material pétreo: desbaste (10,5h/m²) + semielaboración (9,17h/m²) + acabado (10,67h/m²) a los cuales se debe añadir el transporte[9], y la puesta en obra. Basándonos sobre los trabajos ya publicados y los presentes en este volumen, cabe subrayar que la definición de las etapas responde más bien a una interpretación personal[10], por lo consiguiente sería necesario lograr una uniformización tanto de las definiciones como de la metodología de los cálculos. Así, el análisis de las técnicas edilicias obliga a tener en cuenta hasta el uso de las herramientas, la explotación de las canteras[11], el transporte y la puesta

3 DeLaine 1997, 2001.
4 Duncan-Jones 1995.
5 Vallejo Triano, Fernández Barba 2010.
6 Bernardi 2011.
7 Pegoretti 1863, 1864.
8 Se trata de una investigación con resultados en proceso de publicación en la que se tomaron unas 80 muestras con el objetivo de plantear un mejor entendimiento del ciclo de la piedra desde la explotación de la cantera hasta el reuso de los sillares de calcarenita en edificios antiguos de Córdoba. Este trabajo forma parte de un proyecto de investigación dirigido por el Prof. Dr. Carlos Márquez "*Exemplum* et *spolia*: el legado monumental de las capitales provinciales romanas en Hispania. La Córdoba romana y su reflejo en la ciudad posterior".
9 Russel 2013; Scheidel 2013; Pensabene, Domingo 2016.
10 Mar, Pensabene 2009: 373. Domingo, Domingo (2017) proponen en su trabajo una mera definición de aquellas etapas.
11 Gutiérrez Garcia-M., Rouillard 2018.

en obra[12] con el objetivo de determinar la organización de la cadena operatoria[13] y el tiempo de trabajo. En este sentido, cabe subrayar los trabajos publicados en la Arqueología de la Construcción[14] que ofrecen un compendio de experiencias sobre la explotación de las canteras en el mundo romano teniendo en cuenta distintas clases de recursos pétreos[15].

Los costes de producción son en realidad la parte final de una larga y compleja reflexión en la que se debe analizar el edificio en su totalidad, así como la producción de los recursos y su distribución[16]. Pero no sólo, esta clase de investigación consiste también en restituir toda la cadena operatoria para la elaboración definitiva del material pétreo (calcarenita, mármol, ladrillo etc.)[17] dentro de los conocimientos de cada yacimiento. Al no dar este paso, convendría aceptar que nuestro entendimiento de los edificios premodernos sea parcial. En muchas ocasiones, la investigación se focaliza en un edificio entero, pero dicha metodología es también aplicable para las reparaciones, y el fenómeno spolia[18].

El potencial de esta línea de investigación es enorme, puesto que existen numerosos factores directos e indirectos que afectan el coste de producción, de ahí la necesidad de incluir en futuros trabajos aspectos sociales (contratos laborales[19], esclavos en la construcción[20]) y antropológicos.

¿Por qué realizar un estudio cuantitativo y evaluar el coste de construcción?

Al conocer los límites de esta clase de investigación que se basa en estimaciones -más bien para el coste-, conviene justificar el interés de dicha metodología de investigación. El lector no debe creer que los autores están a la búsqueda de la verdad, reemplazando fuentes antiguas por un estudio cuantitativo; al contrario, se trata de llevar a cabo matices sobre la metodología con el fin de completar una escasa documentación literaria.

La construcción era un pilar en la economía del mundo antiguo siempre asociado a objetivos políticos y sociales; según lo comenta el

12 Adam 1989 ; Bessac 2007, 2018 ; Zugmeyer, Badie 2012.
13 Curvigny 2005; Pensabene, Mar, Cebrián 2012.
14 Bonetto, Camporeale, Pizzo 2014.
15 Existen numerosas publicaciones sobre la explotación del mármol, citamos a modo de ejemplo las reuniones de Asmosia, o bien García-Entero (2014).
16 Russell 2013.
17 Barresi 2003; Mar, Pensabene, 2009; Domingo 2012; Courault 2015.
18 Barker, Marano 2017.
19 Rodríguez Neila 1999; Domingo 2013.
20 Coarelli 1977; Torelli 1980; Feyel 2007.

Digesto, cualquier particular podía construir sin autorización del príncipe a no ser que fuese un teatro, anfiteatro, circo, fortificación[21]. Aunque según otras fuentes antiguas (Polibio, Cicerón, *lex Tarentina*) son los magistrados y Senado quienes tenían la máxima autoridad para adjudicar, ejecutar y mantener las obras[22]. Tal como lo recuerda Rodríguez Neila, las inversiones imperiales se concentran en Italia, y en las capitales provinciales, y en algunas ocasiones en ciudades afectadas por catástrofes naturales[23]. Por lo tanto, la principal fuente de financiación debía ser local, las ciudades dedicando un presupuesto para distintos proyectos edilicios[24] pero los ingresos de la ciudad son variables[25] así que «Apenas tenemos información cuantificable sobre las finanzas de las comunidades romanas, ni sobre los criterios presupuestarios que utilizaban». La impulsión del evergetismo edilicio fomentaba aún más el aspecto monumental, aunque podía provocar un elevado coste la ciudad para mantener aquellas estructuras[26]. El evergetismo edilicio se encuentra por supuesto a distintas escalas por lo que permitió realizar proyectos urbanísticos sin ninguna prisa y con un plazo sin verdadero límite, tal como fue el caso de las murallas de Cartago Nova[27]. Sin embargo, a veces es escasa la frontera entre la obligación de participar en los gastos de la construcción y el don[28].

Por mucho que la epigrafía nos informa sobre los precios de edificios públicos, cabe preguntarse si se trata de los precios concretos, y sobre qué base fueron elaborados, puesto que puede existir una notable diferencia entre la fuente y las estimaciones que son más importantes[29]. En otras palabras, tal como lo puso en relieve Rodríguez Neila «(…) tenemos escasa información cuantificable sobre los costes concretos de las construcciones públicas»[30]. Existe un vacío en nuestros conocimientos al entender el impacto económico de la construcción, cuando el imperio romano era una

21 Melchor Gil 2009: 146.
22 Rodríguez Neila 2009: 172.
23 Rodríguez Neila 2009: 177.
24 Duncan Jones 1974, 1994. Andreau (2016: 44) propone cinco categorías para clasificar los ingresos de la ciudad: los inmuebles, tierras de cultivo y pastoral pertenecientes a la ciudad, el resto de su patrimonio (canteras, minas, etc.); las tasas, las multas; y los honorarios como colaboración de los notables al acceder a cargos políticos.
25 Andreau 2016: 44.
26 Melchor Gil 2009: 150.
27 Ramallo Asensio 2003.
28 Andreau 2016: 46-47.
29 Domingo 2012; 2014.
30 Rodríguez Neila 2009: 179.

sociedad altamente urbanizada[31]. De ahí el interés de estudios cuantitativos como evaluación sobre la fiabilidad de las fuentes[32], entonces conviene no confundir el coste de producción (resultado de lo cuantitativo) respecto al precio del edificio (respondiendo a una plusvalía).

Los estudios cuantitativos son necesarios puesto que el volumen del material empleado es de por sí una información capital para la arqueología de la construcción y la economía. A partir de ahí se pueden hacer varias estimaciones sobre los días laborales, la producción de detritus/desgastes[33]; y teniendo en consideración todo lo dicho anteriormente, todo ello permite darnos cuenta del volumen laboral que implica cualquier edificio. Por mucho que el tiempo de construcción se basa sobre la interpretación de manuales del siglo XIX[34], y en algunos casos en arqueología experimental, ofrece una perspectiva más real sobre el esfuerzo humano; pero en absoluto, permite calcular con precisión el inicio y final de un proyecto, dicho resultado constituye una base de reflexión para enfrentarse a problemas cronológicos, por ejemplo, las murallas republicanas de Corduba y de Roma en época republicana[35].

Solamente multiplicando los estudios cuantitativos, seremos capaces, además de identificar con mayor precisión la cadena operatoria, así como conocer el funcionamiento y la gestión de los recursos humanos y naturales, estimar el impacto de la construcción de un edificio en la sociedad que sea elaborado a base de material nuevo o reutilizado. En otros términos, estamos convencidos de que aplicar la metodología cuantitativa en la arqueología de la construcción asociada a la historia económica permitirá plantear nuevas bases de reflexión. En este sentido, esta obra abarca un elenco de edificios públicos (murallas, teatro, foro) dentro de una amplía cronología desde los inicios de Roma hasta la Antigüedad Tardía, teniendo en cuenta la variedad de los materiales (tierra, calcarenita, grey, molasse, roca volcánica, mármol, mortero); y eso, siempre dentro de una perspectiva en la que el edificio corresponde al resultado definitivo tras una serie de transformación de los recursos naturales.

31 Russel 2013: 5.
32 Domingo 2012b, 2014.
33 Courault 2016, Bernard 2018.
34 Baker, Russell 2012.
35 Courault 2015.

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Assessing the Economic Impact of Building Projects in the Roman World: The Case of Late Republican Italy

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Abstract

Since the pioneering studies of Janet DeLaine in the mid-1990s, the modelling of labour force and construction costs has developed into a specialised sub-field of Roman archaeology. In recent years, it has seen a certain rise in popularity, as demonstrated by a series of international conferences, monographs and edited volumes. Goals and methodology of this particular academic sub-discipline are primarily practical in nature: Estimates of labour force, building materials and construction costs are used in order to model the duration and logistics of specific building projects. Ideally, this can lead to a deeper understanding of Roman construction in the form of various case studies which are analysed in depth but mostly in isolation. In terms of theory, the deeper aims and the heuristic potential of this approach are much less well defined. It seems particularly striking that, so far, the intricate complexities of modelling have not yet been matched by an equally complex attempt at interpretation. Therefore, by drawing upon the case study of late republican Italy, the aim of this paper is to sketch out a theoretical framework which goes beyond conventional practice in order to address broader issues of analysis: What is the contribution of construction costs to wider debates on the Roman economy? How does the cost and mode of construction relate to society and politics? And what does the variegated process of construction tell us about the changing nature of socio-economic power relations in the Roman empire? Preliminary answers to these questions are given by drawing upon the first results of a macro-study of the late republican building industry, based upon volumetric modelling and on an in-depth analysis of supply-chains and architectural logistics. The results call for a profound re-assessment of the impact of building projects on the Roman economy.

Keywords

Roman architecture, labour costs, late Roman republic, social history, Roman economy.

Introduction

From the late 19th century well into the late 1980s, Roman architecture was mainly the remit of art historical approaches, dealing first and foremost with questions of design and aesthetics.[78] Ancient architects were predominantly seen as artists, and consequently the process of design as well as the final visual appearance of Roman buildings was largely analysed in terms of art history.[79] The underlying process of construction was separated from the artistic 'superstructure' and mostly reduced to its technological and chronological aspects, such as the invention of specific technologies or the use of different building materials.[80] Consequently, in Roman archaeology, construction techniques were predominantly used as dating evidence for particular buildings, whereas the socio-political significance of Roman architecture was by and large based upon the assessment of architectural design, decoration and function.

Since the 1990s, the scope of studies in Roman architecture has dramatically expanded to a much wider range of topics, with key interests in form and style, political interpretation, social significance and cultural history.[81] Consequently, in a recently published review article, Henner von Hesberg and Johannes Lipps concluded that, after decades of art historical approaches, the analysis of Roman architecture at the beginning of the 21st century could ultimately be characterised by its compartmentalisation in a set of hyper-specialised sub-disciplines. Amongst these they identified approaches driven by influences from cultural anthropology, history of ideas and space theory, but also by the sheer amount of data generated from excavation projects and new recording technologies, especially IT-applications and scientific methods. In more general terms, this reflects a growing degree of specialisation within current studies on Roman architecture.[82]

However, there is an obvious downside to this development, namely the scarcity of overarching studies which look at Roman architecture in a larger, transregional or even empire-wide perspective. Even though some

78 Riegl 1927: 23-82; Wheeler 1964; Drerup 1966; Rakob 1967; MacDonald 1982; Sear 1982; but recently also Wilson Jones 2003 and Taylor 2007.

79 E.g. MacDonald 1982: 122-142.

80 Technologies: e.g. *opus caementicium*: Coarelli 1977; Torelli 1980; Rakob 1983 and the gradual rationalisation of tools and fabrication techniques: Pfanner 1989; building materials: e.g. Lugli 1957; MacDonald 1982: 143-66; Adam 1984.

81 A useful general introduction is provided by Ulrich – Quenemoen 2015.

82 Lipps – von Hesberg 2010-2011: 226-30.

significant works have been published over the last two decades, they, by and large, still followed the traditional approaches of dealing with architecture as art history,[83] or relating to specific periods,[84] technologies,[85] and building types.[86] The principles of social history were never fully applied to Roman architecture, with the notable exception of James Anderson's monograph dedicated to 'Roman Architecture and Society'.[87] At the same time, approaches towards the broader cultural significance of Roman architecture have largely concentrated on domestic buildings[88] or, despite the inclusion of innovative concepts such as 'hybridity', 'acculturation' or 'identity', were laid out along the traditonal lines of chronologically structured narrative, focused on the development of architectural styles and types.[89] By contrast, the ever-growing masses of recorded and published architectural data for the *construction* of Roman buildings have not yet been synthesised and evaluated in a meaningful overarching framework.

Labour force, construction costs and the roman economy: separate tables?

In line with this general tendency towards particularisation and the separation of architectural history from construction history, the method of estimating labour force and construction costs until now has been restricted to a specialised subdiscipline which approaches the logistics of Roman architecture by means of quantitative analysis. This way of looking at the processual aspect of Roman construction was pioneered in 1997 by Janet DeLaine in her seminal study on the baths of Caracalla in Rome. By looking at the physical properties and building materials of this particular architectural complex, she established a model for the schedule of the construction works from which she then deduced the most probable figures for the required workforce and the building effort, measured both in time ('man-hours' and 'man-days') and costs, given in equivalents of the *modus*

83 Wilson Jones 2003; Senseney 2011; Favro *et al.* 2015.

84 Darwall-Smith 1996; Thomas 2009; Lusnia 2014.

85 Lancaster 2009; Vitti 2016; Van Oyen 2017.

86 Gros 1996 and 2001; Schenk 1997; Stamper 2007; Lackner 2008; Yegül 2010.

87 Anderson 1997.

88 Clarke 1991; Wallace-Hadrill 1994; Dickmann 1999; Hales 2003.

89 von Hesberg 2005 or, on early Rome, Hopkins 2016.

castrensis, a measure for grain, derived from the price edict of Diocletian, which can also serve as a basic indicator for income in terms of subsistence.[90] In recent years, DeLaine's approach has seen a certain rise in popularity, as demonstrated by a series of international conferences, monographs and edited volumes.[91] Goals and methodology of this particular academic subdiscipline are primarily practical in nature: Estimates of labour force, building materials and construction costs are used in order to model the duration and logistics of specific building projects.

This approach relies on the use of comparative sources for pre-industrial construction techniques and the management of building materials and human resources. The most valuable of these sources are 19th century building manuals which explicitly relate to the process of building before the large-scale use of engine-driven machinery.[92] The total costs for each individual building project are the sum of the costs of raw materials and resources (derived from literary and epigraphic evidence for the respective time periods), the costs of transport (in wages, depending on the duration of transport) and the costs of labour (again, in wages, depending on the duration of the construction workers' specific tasks). In a recent review article, Simon Barker and Ben Russell were able to demonstrate the validity of DeLaine's method by means of experimental archaeology, drawing especially upon the observation and practical application of traditional methods of stone carving.[93] Moreover, the now increasingly widespread use of virtual reconstructions allows for a highly accurate calculation of volumes and surfaces which is indeed crucial for applying the information of the 19th century building manuals to Roman architecture.[94] There also have been recent attempts to substitute the generic measure of the *modus castrensis* for hypothetical *monetary* building costs by considering Roman wages and prices.[95] Taken together, these approaches provide a substantially new foundation for looking at the real costs of Roman building in a wider, socio-economic context.

90 DeLaine 1997, 2000, 2006, 2017, 2018. For the use of grain equivalents and the *modus castrensis* in order to reconstruct Roman wages and living standards cf. Scheidel – Friesen 2009: 64-73; Scheidel 2014; Groen-Vallinga – Tacoma 2016.

91 E.g. Barresi 2003, 2004; Arqueología de la construcción I-V; Bernard 2018; Brysbaert *et. al.* 2018.

92 Pegoretti 1843; Hurst 1886. Cf. DeLaine 1997, 2000, 2006, 2017.

93 Barker, Russell 2012.

94 See i.a. the excellent work by Limoncelli 2009, fruitfully used as a basis for the estimates in Maschek 2016b.

95 Barresi 2003, 2004; Domingo 2013; Maschek 2016b.

However, in terms of theory the deeper aims and the heuristic potential of this approach are much less well defined. It seems particularly striking that, so far, the intricate complexities of modelling have not yet been matched by an equally complex attempt at interpretation. Therefore, the aim of this paper is to sketch out a theoretical framework which goes beyond conventional practice in order to address broader issues of analysis: What is the contribution of construction costs to wider debates on the Roman economy? How does the cost and mode of construction relate to society and politics? And what does the variegated process of construction tell us about the changing nature of socio-economic power relations in the Roman empire?

These questions are of particular importance because architectural remains – possibly due to the fact that they were seen as firmly located within the traditional, art historical remit of Classical and Roman archaeologists – were largely ignored by generations of ancient historians working on the Roman economy. Even though construction did indeed feature in Tenney Frank's monumental study on Roman economic performance, he almost exclusively drew upon literary texts and inscriptions and did not consider the archaeological evidence beyond the purely anecdotal.[96] Likewise, eminent historians like Peter Brunt and Richard Duncan-Jones did see public building as a major sector of the Roman economy, but neither of them looked at the archaeological material. In Brunt's work there is a clear focus on literary texts, while Duncan-Jones used mainly inscriptions for his well-known analysis of Roman construction costs[97].

Moreover, in Moses Finley's much discussed primitivist reading of the ancient economy, construction works did not play any role at all,[98] and in comparison with the dominant themes of agriculture and artisanal production they are also only passingly mentioned in more recent handbooks and publications on the Roman economy. For example, in the 'Cambridge Companion to the Roman Economy', edited by Walter Scheidel in 2012, there is no dedicated chapter on construction; apart from occasional remarks, matters relating to the building industry are only briefly mentioned in the two chapters authored by Andrew Wilson (on raw materials) and Paul Erdkamp (on urbanism).[99] Equally, in Philip Kay's excellent 2014 monograph on 'Rome's Economic Revolution', some

96 Frank 1933, 1937, 1938, 1940.

97 Brunt 1980; Duncan-Jones 1965, 1990: 59-67.

98 Finley 1973.

99 Erdkamp 2012: 251-3; Wilson 2012: 138-40, 143-4.

construction and building projects are discussed on roughly twenty pages out of four hundred, despite the fact that the famous denarius from 56 BCE (RRC 425), depicting the Aqua Marcia, was selected for the front cover[100].

Thus, we cannot but state an obvious and deep-reaching problem of communication: Roman *archaeologists* do have an established methodology for modelling the construction costs of particular buildings, but scholars working on the key questions of the Roman *economy* hardly seem to notice. In my view, the reason for this is clear: it is an issue of both *scale* and *quantity*. Economic historians like to ask big diachronic questions – but archaeologists, in a rather more cautious-minded way, tend to focus on specific buildings and time periods. In other words, from a vast amount of available data such archaeological studies produce very little in terms of overarching interpretation. With regard to the relevance of archaeological data for construction in the Roman world, the consequences of this methodological divergence are detrimental. For example, in his rather controversial study of the Roman economy, published in 2013, Peter Temin states that public building activity in Rome and the empire during the Principate was 'episodic' and 'sporadic'.[101] From an archaeologist's perspective, this is an obvious misjudgement which can only be explained with a certain lack of familiarity with the epigraphical and archaeological evidence relating to Roman imperial architecture. However, amongst ancient historians Temin is not alone in making such assumptions, and this is probably due to the archaeological emphasis on certain imperial 'cameo projects' which were sponsored by the emperors in the city of Rome, such as the Colosseum or the baths of Caracalla.[102]

100 Kay 2014: 2, 10-1, 24, 65, 70, 216-28, 230, 233, 279-81, 286, 301-3, 306-10.

101 Temin 2013: 106, 116.

102 See i.a. Erdkamp 2012: 251-2 and Kay 2014: 225-6 who both consider DeLaine's 1997 study on the Baths of Caracalla as a useful yardstick for widely extrapolating on the size of the Roman construction industry, regardless of the huge diversity of geographical and chronological settings over the course of Roman history for which such a 'one-size-fits-all' approach can hardly be feasible. A more nuanced view can be found in Wilson 2006 and Erdkamp 2016.

From the micro-to the macro-scale in the estimation of labour and construction costs: urbanisation in late Republican Central Italy

In the remaining part of this paper I shall discuss a case study which should allow us to bridge this divide and go beyond the traditional focus on individual buildings by looking at a much vaster pool of data, which can be used in order to make a significant contribution to current debates on the Roman economy and Roman republican history. The context for this is the well-known wave of large-scale urbanisation which swept over most parts of western central Italy during the 2nd and 1st centuries BCE.[103] In Helene Jouffroy's extensive but by no means complete gazetteer of 1986, we find no less than 165 archaeologically attested monumental buildings such as porticoes, amphitheatres, theatres, infrastructure buildings, city walls, sanctuaries and temples in central Italy between 150 BCE and the Augustan period, *excluding* the city of Rome.[104] Moreover, there are 100-odd building inscriptions of monumental construction projects from Latium and Campania for the 2nd century BCE and the pre-Augustan decades of the 1st century, mentioning more than 200 individual magistrates actively involved in public construction works.[105] This means that, for a period of 120 years and for a comparatively small geographical area, *excluding* Rome and any sort of private and residential construction, we have indeed archaeological and epigraphic evidence for no fewer than some 240 monumental building projects. This equals roughly two buildings per year and clearly does not deserve the label 'sporadic'[106].

But the real importance of these buildings does not reside in their sheer numbers. They are important because for each of them, based on their extant architectural remains, we can hypothetically model the duration of the construction project, the total costs and the numbers of skilled and unskilled workers involved. Taken together, this produces exactly the kind of models which economic historians and economists rightly crave. To

103 Gabba 1972; Torelli 1983; Lomas 1998; Laurence 2001; Morley 2001; Morley 2002: 174-83; Patterson 2006: 89-183; Morley 2008; Wallace-Hadrill 2008: 103-210; de Ligt 2012a: 193-246; de Ligt 2012b.

104 Jouffroy 1986: 16-58.

105 Cébeillac-Gervasoni 1990, 1991, 1998: 66-79, 118-25.

106 A similar impression can be gained from the enormous database of urban sites and buildings of imperial date, recently compiled and published in Hanson 2016 and http://oxrep.classics.ox.ac.uk/databases/cities/ (last accessed 21/01/2019).

illustrate this I shall focus on one particular aspect, namely the potential impact of the building industry on urban and rural communities in the late republican period which was marked by vigorous urbanisation. To start with a modern scholar, David Harvey, urbanisation can be understood as a process which first and foremost is geared towards the constant absorption of surplus capital.[107] Based upon the analysis of both literary and archaeological sources, it is obvious that similar processes were also at work in late republican Italy.[108] Local bigwigs put their money into construction projects and urban development throughout the late 2nd and 1st centuries BCE. However, the differences to modern (urban) capitalism were striking. In the towns of late republican Italy we do not find many of Harvey's upstart investors but first and foremost the members of local, landowning elites who were not only interested in financial but also in social capital.[109] Euergetism and conspicuous spending played a key role in their investments – and building projects were high up the list of prestigious donations.

As briefly sketched out in the introduction to this paper, traditional strands of scholarship have focused more on the ideological and aesthetic qualities of such buildings. However, their wider significance for the economic and socio-political history of late republican Italy has never been analysed at a larger geographical scale, going beyond the narrow focus on isolated buildings or specific building types. In order to address this imbalance I will discuss the first results of a macro-study of the late republican building industry, based upon volumetric modelling and an in-depth analysis of supply-chains and architectural logistics.

Some of the monumental buildings I have studied so far, such as the late republican terraced sanctuary at Tusculum[110], the so-called 'Nicchioni' at Todi in Umbria[111] and the 1st century CE marble stoa at Hierapolis in Phrygia[112], make it very clear that between 25 and 33% of the total investment in such projects were probably used for paying the workforce. Moreover, I have suggested that between 10 and 15% of these wages would have been paid for the upkeep of slaves, whereas the remaining 85 to 90% would have gone

107 Harvey 2012: 5-25, 35-57.

108 Treggiari 1980; Baratto 2003, 2004; Weis 2005; Flohr 2012; Mayer 2012: 37-41, 54-8, 66-85; Flohr 2016.

109 Wallace-Hadrill 1991; Dyson 1992: 56-88; Lomas 1997; Parkins 1997; Pobjoy 2000; Erdkamp 2001; Lomas 2002.

110 Maschek 2016a; 2017.

111 Maschek 2013.

112 Maschek 2016b.

to freeborn workers from urban centres and their agricultural hinterland.[113] This demonstrates beyond doubt the huge economic impact of Roman building projects: On the one hand, they were vital for the subsistence of a significant part of the *urban* population; on the other hand, they were also essential for people living in the countryside who would have worked as seasonal day-labourers on construction sites, a model which is both known from ancient literary sources and other documents and further corroborated by modern anthropological studies in India and Latin America[114].

But large-scale modelling allows us to go beyond such rather simplistic ratios, in particular when it comes to the chronological and geographical dynamics of the construction industry in late republican central Italy. If we take the 170-odd monumental buildings for which we have secure archaeological evidence and break them down into two time periods, we see significant changes in the three generations between 150 BCE and the middle of the 1st century[115].

Between 150 and 100 BCE, the distribution of investment in construction shows clear disparities between the regions of central Italy, and in particular Latium, Samnium and Campania (**Fig. 1**). This is mainly due to the fact that the building projects in these regions, and in particular the famous terraced sanctuaries, were *by no means uniform* in terms of size, building materials and techniques, and therefore they required different amounts of funding and also different numbers of skilled and unskilled workers. The by far largest number of both skilled and unskilled labourers was only needed in a very small geographical area of central and southern Latium which, due to the pull-factor of the big construction projects, must

113 Maschek 2016a: 324-27; 2016b: 398-401; 2017: 174-6.

114 For seasonal labour in the Roman construction industry see Brunt 1980; Skydsgaard 1983; Martin 1989: 69-71; Anderson 1997: 119-27; DeLaine 1997, 197. Important in-depth discussions of the socio-economic impact and importance of seasonal migration in Roman Italy, including reference to osteoarchaeology and comparative anthropological evidence, can be found in Hin 2013: 232-45 and Erdkamp 2016: 38-40, 48-9.

115 For the sake of this preliminary study, the monuments were split into five different building types (sanctuaries, city walls, porticoes, market buildings, basilicas) and five distinctive cost-groups according to building type and technique. Based on the detailed estimates in Maschek 2013; 2016a, b and 2017 the following benchmarks were established: 1) *small stone building* (ashlar, columns): 300.000 HS; 2) *medium-sized stone building* (ashlar, columns): 960.000 HS; 3) *medium-sized building, opus caementicium* with little terracing: 850.000 HS; 4) *medium-sized building, opus caementicium* with substantial terracing and vaulting: 1.350.000 HS; 5) large building, *opus caementicium* with substantial terracing and vaulting: 16.600.000 HS. The resulting estimates are comparatively rough and will have to be refined through further in-depth analyses. Nonetheless, they provide a good impression of the general orders of magnitude involved in late republican construction work.

have been a prime target for seasonal and long-time migration. At the same time it becomes very clear that also the towns *surrounding* these few leading centres in Latium invested in public buildings and infrastructure. This trend was perhaps partly due to the availability of larger numbers of builders and skilled workers. Latium in particular can therefore be singled out as *the* major boom-zone of late republican urbanism; here, a minimum of 50 million sesterces was invested in construction between 150 and 100 BCE.

In the second period from 100 to 50 BCE this overall pattern changes significantly (**Fig. 2**). The main reason for this is the massive increase of investment in fortifications. Against the backdrop of the well-known political turbulences and endemic insecurity in these decades it is fair to assume a correlation between this trend and the events of the Social War and the following civil war.[116] However, looking at it from an economic point of view, it is truly remarkable that, despite the violent upheavels of the period, the level of investment in Latium remained virtually unchanged at a minimum of 50 million sesterces. For other regions, in terms of the building industry, the first half of the 1st century BCE was even a veritable gold-rush period: In Campania and Umbria investment tripled in comparison with the previous 50 years: Campanian towns now had expenditures of at least 8 million sesterces, predominantly for urban fortifications, and towns in Umbria spent a minimum of 2 million sesterces.

As mentioned before it is important to bear in mind that 25 to 33% of these building costs were spent for transport and wages[117]. In Latium, monumental building projects would consequently have provided workers' wages worth at least 12,5 million sesterces in each of the two 50-year periods from 150 to 50 BCE. Between 100 and 50 BCE, a minimum of 2 million sesterces would have been spent on workers' wages in Campania, 400.000 sesterces in Umbria. To put this into perspective it is useful to know that as a special benefit soldiers in 69 BCE received 3.500 sesterces each, at a time when a skilled worker could make roughly 500 sesterces per year.[118] The money paid for wages in the monumental construction projects in Latium would thus have equaled the one-off benefits for 3.500 soldiers, which is not even a full legion. At the same time, they would also have been more than sufficient to pay the annual salaries of no fewer than 25.000 skilled workers.

116 Further on this see Maschek 2018: 174-204.
117 Cf. Maschek 2016b: 399-401.
118 Scheidel 2007:330-3; Kay 2014: 286-7; Maschek 2016a: 325. For salaries in the Roman construction industry (with a particular focus on the imperial period) see Domingo 2013 and Groen-Vallinga – Tacoma 2016.

The building industry was therefore a crucial factor in the economy of urban centres in late republican central Italy. Far from being 'sporadic', monumental construction projects needed and attracted a large workforce, while at the same time constantly refining the implementation of specific building technologies. The widespread implementation of *opus caementicium* must be seen in this context. It certainly had a profound impact on local and regional economies and on the labour market – but in a very different way than coventionally assumed in scholarship where the large-scale implementation of concrete is essentially linked to its higher efficiency and the slave mode of production.[119] However, slave labour was in many situations actually a poor choice when compared to the seasonal employment of unskilled workers from the agricultural sector. It was exactly this large pool of freeborn labour which was deliberately tapped by the change in construction technology from *opus quadratum* and traditional terracing to *opus caementicium* and the innovative creation of large substructions in late 2nd and early 1st century BCE central Italy. Moreover, the high demand for skilled masons could presumably only have been satisfied by the effects of vigorous urbanisation in the late 2nd century BCE: These people came from a new kind of urban and increasingly specialised labour market which emerged in the process of what Philip Kay has so aptly called 'Rome's economic revolution'[120].

Conclusion and methodological perspectives for future studies on the roman construction industry

It is my deep conviction that only by analysing massive datasets of the kind discussed in the previous section we are in a position to create the foundation for a comprehensive model of the Roman construction industry at different scales, ranging from the single building to local, regional and, ultimately, interregional or empire-wide studies. Such multi-level analysis offers the opportunity to identify similarities and

119 For the ‚communis opinio' regarding the economic impact and advantages of *opus caementicium* in the 2nd and 1st centuries BCE see i. a. Delbrueck 1912: 179-80; Lugli 1957: 363-444; Coarelli 1977: 9-19; Torelli 1980; Rakob 1983; Torelli 1983: 247-50; Adam 1984: 79-90; Pfanner 1989: 172-74; Anderson 1997: 145-51; Wilson 2006: 226-7; D'Alessio 2010: 52. 54-5; Davies 2017a: 161-5; Davies 2017b: 83-99; Van Oyen 2017: 136-50. For a more nuanced view on both public and domestic architecture see Mogetta 2015 and 2016.
120 Kay 2014: 6-7.

differences in work-schedule, resource-management, transport, labour demand and total costs. Ideally, these should be analysed in multiple *synchronic* as well as *diachronic* perspectives by means of applied multivariate statistics and statistical tools for spatial analysis in GIS. This could include the creation of heatmaps in order to visualise the intensity of investment in building in certain periods; it could also entail spatial correspondence analysis of the correlation between the investment in construction and the demand for seasonal labour within certain catchment areas. All this would allow for the identification of meaningful patterns and for their historical interpretation. At the same time and regardless of scale, there should always be a transparent set of measurable parameters behind the explanatory models which would allow for the testing of *diverging* hypotheses, for example on the choice of different building materials or technologies and their impact on the logistics and costs of construction. In my view, such a complex methodology would guarantee for the creation of extremely robust, testable and comparable historical models[121].

If archaeologists working on ancient construction want to be heard and to be taken seriously in debates on the Roman economy, it needs exactly such a profound shift in the scale of analysis: we should go beyond the modelling of individual building projects and move towards large-scale interpretation of the type I tried to exemplify through my case study. This requires an ambitious approach in terms of the chronological and geographical framework – an approach which transcends the traditional focus on isolated buildings or sites. We need to look at a much larger sample of buildings and at a much wider timeframe and geographical scale than ever before. More specifically, it will be necessary to assemble comprehensive empirical datasets for the large-scale modelling of the Roman construction industry in as many parts of the empire as possible, ideally within a widely shared collaborative framework based upon easily accesible online resources.[122] Only huge datasets will generate new results for the reconstruction of the role of building within the Roman economy, putting us into a position to revise existing models and discussions such

121 In general cf. Brughmans – Poblome 2016; Brughmans – Poblome 2017.

122 A collaborative international online database on the costs of Roman construction is currently under preparation, initiated by Christopher Courault and Javier Domingo. The huge potential of such frameworks can be gauged by looking at successful projects of a similar nature, e.g. 'Coin Hoards Roman Empire' (http://chre.ashmus.ox.ac.uk/, last accessed 21/01/2019) and 'The Oxford Roman Economy Project' (http://www.romaneconomy.ox.ac.uk/, last accessed 21/01/2019).

as the traditionally separate treatment of agricultural (rural) and artisanal (urban) production[123].

In a broader sense, such a new large-scale approach to the Roman construction industry could also produce impact which goes well beyond the archaeological core disciplines. For example, the results of such a study would also be relevant to modern economic theory which relies strongly on the evaluation of historical data in order to identify economic trends and cycles, as exemplified in the highly influential works of Douglass North and Thomas Piketty.[124] Archaeologists studying Roman architecture could and indeed should work towards creating interpretative models which can serve as proxies for the economic history of preindustrial Europe, amongst them the level of total investment in construction; construction employment and earnings; diachronic and synchronic differences in wages; demand and supply (and hypothetical price developments) for construction materials; the modelling of construction cost indices for specific periods and regions of Roman Europe; buildings completed in particular time periods and many more.[125] Such models would be of broad interest to researchers in the fields of archaeology, history, anthropology and economic history and theory. Last but not least they also have the potential to transform current paradigms of how the Roman construction industry changed the socio-economic face of the continent between the Late Iron Age and the Early Middle Ages.

123 E.g. most recently Bowman – Wilson 2013; Hawkins 2016; Wilson – Flohr 2016.

124 North 2005; Piketty 2014. Cf. also Scheidel 2017.

125 For a range of such proxies in a modern economic context see Finkel 1997: 21-31. 64-71. 83-8. 113-24. For archaeological proxies and the ancient economy in general: Wilson 2014.

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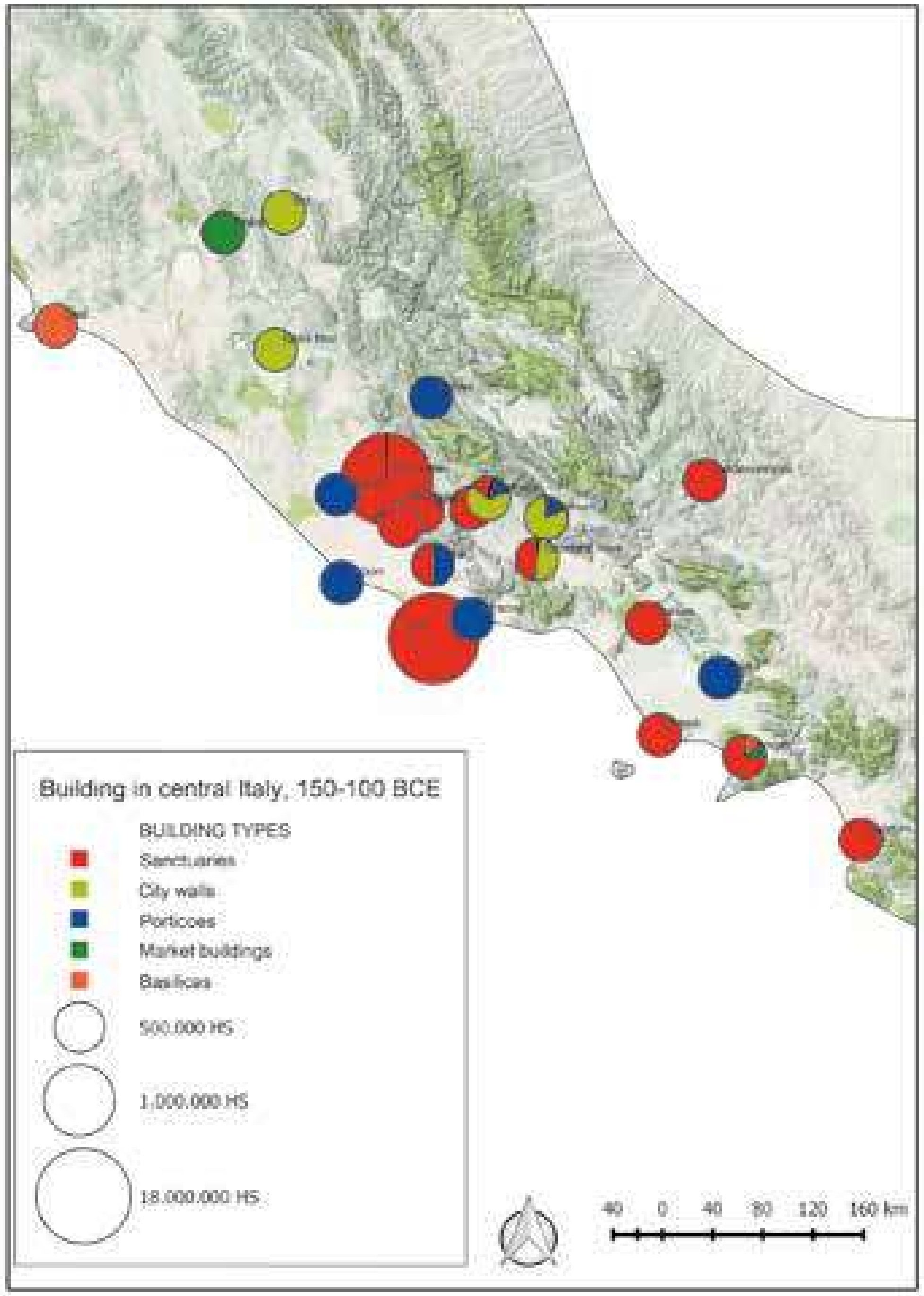

Fig. 1: Distribution of estimated investment in construction in central Italy (150 to 100 BCE); map: D. Maschek

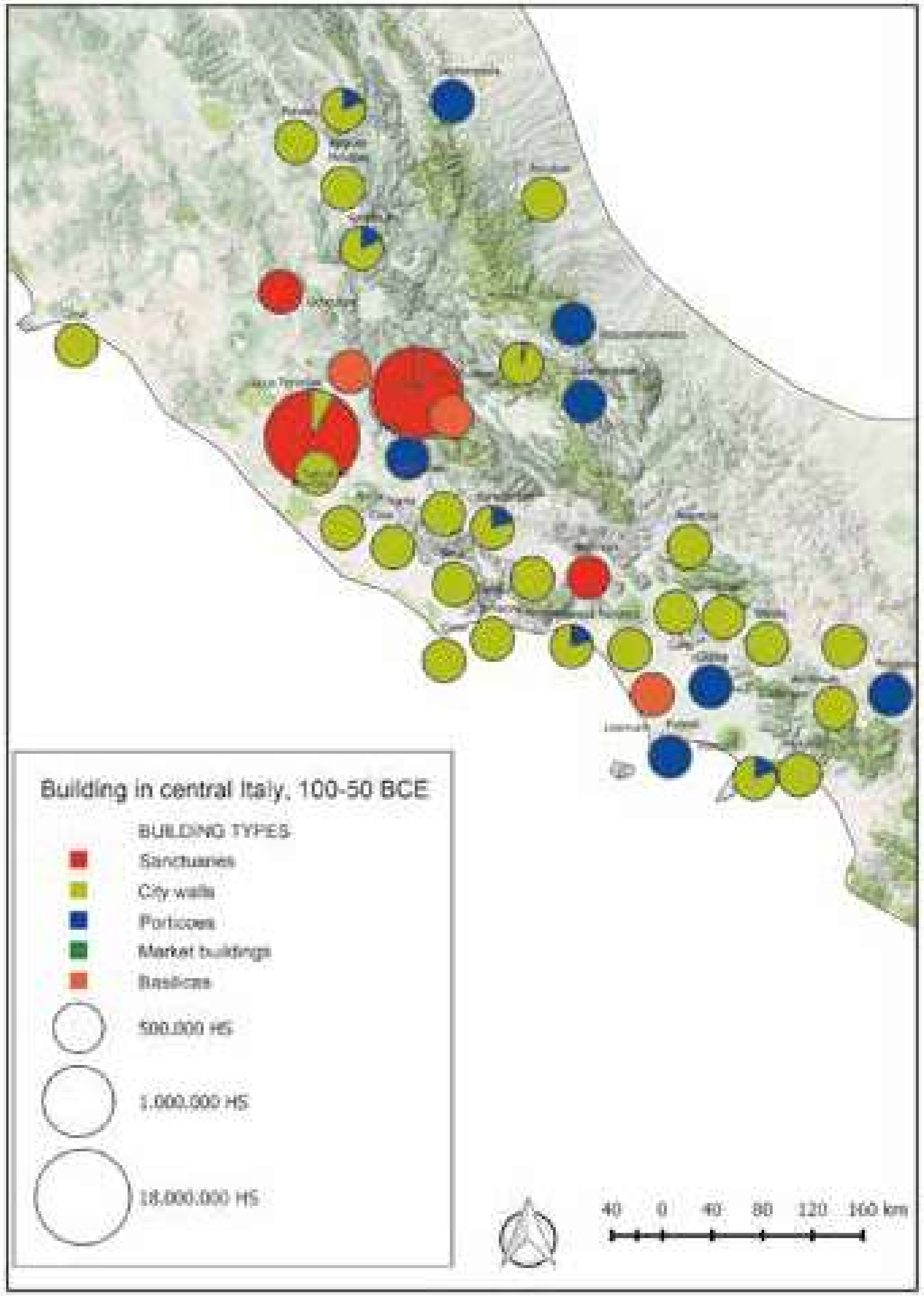

Fig. 2: Distribution of estimated investment in construction in central Italy (100 to 150 BCE); map: D. Maschek