Building BIG – Constructing Economies: from Design to Long-Term Impact of Large-Scale Building Projects An Introduction

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The economic growth of modern societies has been closely linked with construction industries: investments, transport infrastructures for materials and labour-intensive building programmes all have a large impact on local, regional and even global economies. The results have shaped the built environment of our every-day lives and have often led to an increased quality of life and affluence, though there are many contrary cases as well. In past pre-industrial societies whenever large-scale building projects took place, extensive manual labour was invested from the moment materials were scouted for, extracted, transported, employed and subsequently maintained. Since most ancient societies were based on subsistence economies, important decision-making was a daily balancing act between building work and agriculture. These decisions often influenced strongly the patterns of land use and may have resulted in circular economic strategies.

We left, on purpose, the concepts 'monumental' and 'monumentality' out of the title of this session since this has been recently discussed in several papers and books.[1] We wished to direct the focus towards the socio-economic and political structures and decision-making that may have resulted in 'Building Big', irrespective of the shape and final size of the projects. Building Big can also relate to constructing several smaller units, such as housing blocks, port installations,[2] qanat and irrigation systems,[3] and transport and road networks.[4] Any form of large-scale building required matching levels of material resources to be brought over (stones, timber, clay) or moved out (bedrock, earth), and human and animal resources such as quarrymen, foresters, gatherers, movers, builders and transporters. Depending on the socio-political structures of given societies, the human resources could have been treated as normal workers, carrying out an acceptable workload per day, commensurate with their capability. In other situations, we know of exploitation of people because of their status as slaves or prisoners, and thus dispensable as commodities by the elites for whom such structures were built. In such specific cases, in which the monuments on which the human and other energy was expended, often risking lives, there is no doubt that the completed structure exuded power that would have rippled through the entire society. Santillo-Frizell has demonstrated with examples from the Mycenaean sphere and comparative data from modern historical Swedish contexts that building large-scale and long-term was a public act and even a ritual performance to demonstrate where the power sat and over whom it was exercised.[5]

In Greek and Roman Archaeology, research on quantification of materials, labour and transport in construction has been carried out for a long time before its recent rebranding as 'architectural energetics'.[6] For example, Stanier published in 1953 an

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account on the cost of quarrying, transport and construction of the Parthenon. His costs and labour constants are largely based on the preserved building accounts of the temple of Asklepios at Epidauros, but he uses also comparative data on working limestone and marble. He arrives at a total cost of 469 talents for the project,[7] and since the day-wage at Athens is known, this 'price tag' can be translated into ca. 2.8 million man-day labour equivalents and compared with more recent studies.[8] It is very likely that using the epigraphical evidence from Epidauros exaggerates the cost of stone compared to an Athenian context of monumental construction,[9] but Stanier's paper remains a highly valuable early contribution to econometric studies. The question of the cost of building stone is an important one, but studies using it as a proxy for the total costs do not necessarily arrive at well-argued conclusions.[10]

A discussion on econometrics, labour cost studies or architectural energetics is in place here, especially in the context of this conference. The approach has gained some opponents, and correctly so. Most methods need time to mature and adapt to new cases, and along the way they are also refined. Mistakes have been made and will be also in the future. Over the past 20 years it has become clear that care needs to be taken which rates are used and for what purpose. However, carrying out a full review of econometric studies is beyond the scope of this paper, so we will in the following concentrate on the Greek Bronze Age and briefly assess the current state of research.

In past studies, there are cases in which analyses and interpretations are built on a single labour rate and it is quite obvious that this might be problematic. However, most scholars have been working with comparisons of several published rates and arguing for those that, in their contexts, can be regarded as the best-suited ones. These studies carefully explain how their chosen work rates were obtained. A very good example of detailed work is the late Minoan study of eight sites on Crete carried out by Devolder.[11] While not everyone would agree with the eight-hour workday or a fixed building period per structure to determine the workforce that she employed, she did use figures extracted from both the new and old world literature on the topic and covered the materials employed at the different sites, both palatial and non-palatial architecture. She also allowed for partial comparative studies between structures that led to solid interpretations of her data. Consideration of different labour constants and presenting the reasoning behind the most plausible one is also part of the core approach in the papers by Brysbaert on the topic of monumental construction in the Mycenaean context of Tiryns.[12] In contrast to Fitzsimons, Brysbaert emphasises the very costly aspect of transport (as has also been done by Devolder where applicable) and comes to a meaningful discussion on what the figures may mean, depending on the size of the workforce. Furthermore, she also takes the aspect of seasonality into account. Initiating large workforces for long-term projects (or one after the other over a period of time) requires serious decision-making in relation to the constant needs of seasonally driven subsistence provision for both people and animals.[13] Even though Fitzsimons uses a limited range of labour cost units, he manages to compare tomb volume digging among the different types of tombs in and

around Mycenae.[14] It would have been useful to supplement that work with calculating the stonework of the tholoi as well but the comparison nevertheless supports his socio-political arguments across the presented time slice.

Two subsequent levels of critique have since appeared to these studies. The first is that studies on energetics lack any value if the analyses do not produce any further interpretative value in addition to the figures themselves,[15] and it is almost needless to point out that we also believe that this is correct.[16] An analogy can be drawn with carrying out scientific analyses on materials without placing the results back in their context and stating something meaningful about them. Moreover, the high cost of these analyses and their potentially destructive nature both illustrate how pointless this exercise is if not taken any further. Econometric calculations do have value especially when they become the basis for comparative studies.[17] The second point of critique are the rates themselves and convincing cases are being made to employ ranges of rates rather than single figures.[18]

Finally, considering just a handful of papers, Voutsaki and her co-authors[19] observe many serious problems in the quantitative studies on architectural energetics and the use of rates based on absolute, abstract and universal labour-time units because to them the method does not seem objective and transparent. They criticise the approach as inadequate for comparative work due to several factors they regard as random: (1) choice of figures and rates used in the calculations, (2) which steps in the *chaînes opératoires* that are taken into account for the whole process, and (3) employment of minimum figures to calculate the different steps, processes, resources and cost factors. Instead, the authors suggest a 'new methodology' based on relative assessment of labour input.[20] Since this criticism seems to strike at the core of econometric analyses as they are currently carried out by several scholars, a more thorough analysis of the paper is in place.

While we agree that a certain level of personal choice is present in current scholarship on architectural energetics or labour cost studies, we argue that most scholars do in fact carefully consider which rates to use and also explain why.[21] Also, the criticism of 'personal choice' could equally be directed to the selection of scientific techniques used in artefact studies: what matters is how it is being argued for. The same counts for the steps and processes taken into account in the calculations. We agree that it is difficult to be all-inclusive in calculating values for past labour costs but this does not negate the overall interpretive and comparative value of the method. Carrying out the research reveals in most cases that certain cost categories are far more important to the full picture than others, so the omissions are highly unlikely to have any significant effect on the end results. For example, procurement of stone and transport are often among the categories, which most research projects need to consider, but depending on the site, preparing the foundations of the buildings might be a minor cost. As already pointed out, there are several studies, which place the carefully calculated labour-time figures in their physical and social context.[22] In fact, we very much need such figures in order to get to grips with the contextual interpretation of these figures and how they

can be compared to other case studies from different contexts. Osborne argues that there is a dearth of interpretation in studies on architectural energetics,[23] but based on our reading in this field we disagree. Moreover, we also believe that quantitative methods cannot be just swept away by qualitative and relative approaches; we actually believe that they complement each other.[24] Archaeologists also weigh ceramic sherds, bones and shells, they quantify and calculate amounts of grave goods, study different categories of small finds, and enumerate all sorts of other aspects of the archaeological endeavour.

The relative assessment method suggested by Voutsaki, van den Beld and de Raaff[25] in fact misses out on two major factors which can lead to serious interpretive problems: the aspect of time is entirely missing and it does not give any way of estimating the number of people who may have been involved in the construction works. Are not time and the past people involved in the activities two of the major and most indispensable dimensions of the archaeological context itself? In addition, extraction and transport of the stones are assigned arbitrarily into cost categories ranging from 1 to 5. The principle of how the division has been carried out is not explained, not inside each category or in relation to each other. As the authors assert, an extraction value of 5 should not be taken as 5 times more difficult than an extraction value 1.[26] How is it then possible to compare this case study with another one from a different context? The approach sacrifices transparency between procurement and transport of stone, and it will very likely stop the method from becoming more widely accepted.

Furthermore, the new relative method inadvertently results in combining the efforts in the procurement of stone with its transport due to multiplication of the two values. Both values are divided into the five categories. This is highly problematic since transport becomes automatically 'weighted' at the same level as quarrying and extraction. For example: 1 m^3 of stone which is difficult to procure (receives a value of 5) and transport (4) has a 'stone value' of 20, but so would 20 m^3 of small to medium river stones (1) transported from near (1) the cemetery.[27] However, comparison of these two relative stone values of 20 results very easily in wrong ideas about the actual efforts needed to extract and transport each batch of stones since the effort remains physiological being based on the limited capacities of the human and animal bodies. Thus, they are measurable and, to some extent, universal. It should also be pointed out that the authors make several personal choices in terms of what they define as 'significant' variations (type, size, quality of construction of tombs, stone value), thus leaving out other categories (stone density, hardness, cohesion). Considering our argument above this should not be taken as criticism, and it leaves space for others to complement in future work.

Finally, the argument that the tombs were planned and organised in advance[28] would have actually benefited from quantification of the construction process. This would have given an idea of the number of people who would have been needed to carry out this work in the community of Agios Vasileios. Even if people had to travel 4–8 km to the quarry and bring stones back, this would have been within a day's walking

distance or less to transport the size of stones employed in these tombs. Without any labour time calculations, we feel that this paper is on less secure ground to analyse the social implications involving labour force size and time needed than a well-argued econometric study would have been. Having said that, it would be a worthwhile exercise to use the values presented in the paper, carry out meticulous calculations, and see how they compare to the new proposed relative method. The result would give an idea of the required labour force and time when sudden death struck. In this line of thought, let us not forget how fast the city walls of Athens with a length of over six kilometres were built to protect her from her enemies in 479/8 BC.[29]

Despite our critique, Voutsaki, van den Beld and de Raaff's paper forms a very valuable contribution to the field for various reasons. First, the comparative/relative aspects of their method is constructive especially in explaining variation in treatment from one grave to another, and indeed, as the authors state, this is applicable to many other contexts such as housing. Moreover, qualitative assessments can be very useful when combined with quantitative results, so our stance is that both should be carefully combined at the interpretive level. We are not aware of another such attempt to systematically investigate labour and its meaning relative to tomb by tomb context in the Mycenaean world and for that alone, this paper is unique. However, here again, we hope that future studies will combine the useful aspects of their approach with a thorough set of labour cost calculations.[30]

The chapters in this publication combine archaeological, experimental, historical and ethnographic/anthropological perspectives to address the socio-economic and political decision-making needed for the construction projects to materialise. With economic and technological processes of construction as a focus, the contributors consider the following questions:

1. How were large-scale buildings constructed from material, logistical and planning perspectives?
2. What types and levels of resources and investment, human and other, were needed to achieve and sustain these construction projects?
3. Given that construction took place diachronically and geographically more or less worldwide, can we recognise common denominators, and which are these? How can multidisciplinary and cross-cultural approaches further our research in the ancient Mediterranean?
4. In economic terms, is it useful to quantify the necessary resources, how can it be done, and what can such data tell us?

The first three papers concentrate on the Aegean Bronze Age. Ann Brysbaert discusses the infrastructure and logistics required for the monumental architecture in the Argolid in the Mycenaean Late Bronze Age. Moving large blocks required well-built roads between the quarries and the building sites, and transport was one of the most expensive aspects of building programmes. Employing the concept of *chaîne opératoire* to construction and landscape proves to be a methodically fruitful approach in

highlighting the interaction between constructing as well as providing and maintaining the transport infrastructure. Kalliopi Efkleidou studies the large-scale urban planning and construction history of Mycenae as a whole and diachronically from ca. 1400 to ca. 1200 BC. The chapter gives a clear understanding of the development that resulted in spatial reorganisation of Mycenae in two different phases. The large urban projects were initiated by both the elite and palatial authority. Sabine Beckmann's paper concentrates on agricultural sites built using unworked boulders near Agios Nikolaos in eastern Crete ca. 2000–1650 BC. She has identified 330 dispersed sites and their scale and level of investment in the infrastructure implies that they were intended to last a long time. The remains include dwellings, storage structures, enclosures and roads. She considers both horizontal and vertical models of organisation, which could have been the instigators of such large-scale projects.

The four papers of the second part are on Graeco-Roman antiquity. Jari Pakkanen considers the economic impact of Classical and early Hellenistic private construction and whether the total scale of building can be classified under the heading 'building big'. Concentrating on private housing in the Piraeus and at Salamis, the chapter reveals how house design, especially the choice of roof material, influenced the total cost estimates of the houses. The analysis brings us one step closer towards a general understanding of the scale and economic significance of domestic construction in fourth-century BC ancient Greece. Janet DeLaine summarises her econometric research on the early second-century Capitolium at Ostia. The monumental temple standing on a high podium was the largest single investment of resources in the religious landscape of the harbour town. The study highlights, once more, the very high proportion of transport and marble architectural orders in the total costs of Roman monumental building. Anna Gutiérrez Garcia-M. concentrates on monumental building in Tarraco, the capital of the largest western Mediterranean Roman province. The largest local quarry at El Mèdol provided ca. 150,000 cubic metres of limestone for construction projects from the first century BC onwards. The decorative polychromatic stones used in the buildings linked the city with the rest of the province and as far as the eastern Mediterranean. Large-scale transport of building materials overseas inevitably left behind a number of shipwrecks, as the concluding chapter by Ben Russell demonstrates. He discusses the chronology and size of the cargoes. Different commercial mechanisms contributed in different ways to the shipwreck record: however, ships were the primary carrier of building stones over long distances in the Roman Mediterranean.

Notes

[1] Most recently, see Osborne 2014; Brysbaert et al. 2018.

[2] Pakkanen 2013.

[3] Gray 1963; Goldsmith – Hildyard 1984.

[4] See Brysbaert's contribution on the Mycenaean roads in this publication; also Brysbaert et al. 2020.
[5] Santillo Frizell 1997.
[6] Abrams 1994 is one of the best-known early studies using the term.
[7] Stanier 1953. On the Epidauros building accounts, see Burford 1969; Prignitz 2014.
[8] For example, in her contribution to this publication, DeLaine estimates that the volume of material for the Capitolium at Ostia is 3600 m^3 and total cost 270,000 man-days; Stanier's (1953, 76) stone volume is ca. 11,200 m^3 and his calculated total cost is 10 times higher than at Ostia.
[9] The cases where the polis had to import building stone from outside its boundaries like at Epidauros from Corinth, the recorded price is higher than what we know of Athenian contexts; see Pakkanen 2013, 64 f.
[10] See Pakkanen's contribution in this publication.
[11] Devolder 2013.
[12] Brysbaert 2013; 2015.
[13] See now Brysbaert 2020.
[14] Especially Fitzsimons 2011.
[15] Osborne 2014.
[16] Cf. Brysbaert 2016, 20; 2018, 25. 37; both Fitzsimons 2011 and Devolder 2013 interpret their figures and present comparative results, as does Brysbaert 2013, based on figures analysed in 2012 and published in Brysbaert 2015. Pakkanen (2013, 72–74) compares the cost of shipshed complexes in the Piraeus to other monumental Athenian projects and known income and expenditure of the polis.
[17] Boswinkel 2021. His PhD contrasts Mycenaean cyclopean wall construction with house construction of the same period to indicate differences in labour and material efforts. Brysbaert 2020 compares monumental architecture in the Argolid with domestic house construction and pottery production needed for the region, and relates these figures to the efforts of agricultural subsistence production.
[18] Lancaster 2017; Turner 2018, 2020. Lancaster's PhD is on the econometrics of Archaic monumental and domestic building in the territory of Syracuse. Turner's now published PhD on Mycenaean earth works and his arguments why ranges are needed contributes greatly to this point. However, DeLaine (1997, 105) presents a solid argument why estimating the maximum output and minimum costs can produce the most reasonable baseline result for building projects.
[19] Voutsaki et al. 2018.
[20] Voutsaki et al. 2018, 176–180.
[21] See Devolder 2013; Brysbaert 2015. Outside the sphere of Greek Bronze Age: DeLaine 1997 and her subsequent work is excellent; Pakkanen 2013.
[22] See above nn. 16. 21.
[23] Osborne 2014.
[24] See also Brysbaert 2018, 26.
[25] Voutsaki et al. 2018, 176–180.
[26] Voutsaki et al. 2018, 179.
[27] Voutsaki et al. 2018, 176–180, esp. tables 8.1 and 8.3.
[28] Voutsaki et al. 2018, 186.
[29] Thuc. 1.89.3–91.4; 2.13.7.
[30] However, see now Turner 2020 combining both methods.

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