



# Keeping up with the pace of digitization: The case of the Australian construction industry



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## ABSTRACT

The most significant current technological trend is digitization, the impacts of which will be faced by all levels of society. This paper addresses how the Australian construction industry has kept up with the pace of digitization compared with other industries in Australia. The data is drawn mainly from the national accounts hosted by the Australian Bureau of Statistics, within the time period of 1995–2015. Construction has developed into one of the most important industries in Australia. Together with mining and the financial and insurance sector, it has contributed to a significant gross added value (GVA) in the economy. The construction industry has invested around 1% or less in information and communication technologies (ICT) as their share of GVA; however, it has invested about 15% in ICT of their total investments (gross fixed capital formation). Among the selected industries, construction's labour productivity measured by GVA per hour was the third highest, despite low level of investments in digitization. The observed correlation between ICT investments and productivity is weak when using industry level data from the national accounts. Any big leap towards digitization is not recognised for the construction industry; rather there appears to be steady acceptance of the technology.

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## 1. Introduction

### 1.1. Background

The most significant technological trend is digitization. Impacts of digitization will be faced by all levels of society: individuals, communities and entire nations. Through digitization, intelligent sensors, robotics and automation create an unprecedented technological platform for metasystems of consumer products, urban infrastructures and industrial assets. Telecommunications have been integrated into networks which are global and ever-present. With software technologies we are able to increase the logic and autonomy of decision support systems. The World Economic Forum report forecasts that almost one trillion sensors will be connected to the internet by 2025 [35], with countries, industries and sectors setting a different pace with regard to digitization and the

penetration of ICT into everyday life. For example, on the European Digital Agenda Scoreboard, comprising of aspects of connectivity, human capital, use of internet, integration of digital technologies and digital public services, the Nordic countries Denmark, Sweden and Finland were ranked as the top three [12]. Also, industrial sectors seem to be on different phases of learning and utilisation curves.

On the brink of parliamentary elections, the Australian Government recently launched its National Innovation and Science Agenda that lists investments in digitization as one of the key actions. Digital disruption is particularly visible in the “Government as an exemplar” section, which focuses on factors such as public data utilisation, digital marketplaces for government ICT procurement, and pre-commercial procurement in general [9]. Industrial agendas for the digitization of Australian industries are still somewhat scarce although there is no doubt that industrial leaders are well aware of the disruption this challenge will bring [6,15]. World Economic Forum rankings for overall technological readiness places Australia 21st and at 22nd for firm level technology absorption [36].

Technology absorption has been shown to be correlated with

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productivity, although the evidence is not as clear as one would expect [31]. This correlation is obviously not a contributing factor as such, but a result of deliberate strategy to invest in technology, and increasingly in automation and ICT, in order to decrease the relative share of human labour, which is subject to health and safety risks as well as individual variations in productivity. Digital technologies are presumed to increase productivity *per se*, which is not perhaps always as straightforward a case as believed, particularly if digitization is not combined with efficient and streamlined processes or when business ecosystems lack shared understanding of the need for collaborative efforts [19]. Digitization expands into multiple areas, such as product data technologies [28], using mobile technologies *in situ* [8], lean management [30], to name just a few.

Different sectors and industries have long been on different evolution paths when it comes to digitization. In the United States, construction is the least digitalised sector while the financial industry and business services show the highest levels of digitization [26]. Based on Eurostat data, [14], provide a comparison between industries. Again, the construction industry is holding the tail of the list, just before the hotels and restaurants sector. The overall picture from Europe and the US is strikingly similar. A detailed analysis based on national account system data from Finland is provided in Ref. [27], showing that for 1998–2012, the leading sectors in investing in ICT were banking and insurance, information and communications technologies industries and manufacturing industries. A weak correlation between investments in digitization and labour productivity is visible from the Finnish time series data [20].

Australian construction has been publicly perceived as an industry with poor productivity and low level of technology deployment [1]. This perception is clearly challenged by The Australia Institute's brief [29] where the message is that the Australian construction industry's productivity is 53% higher than the Australian industry average for 2012–2013. Also, the importance to the national economy as measured by the gross value added (GVA) and gross domestic product (GDP) is painting a picture of a vigorous and vital industry. The report further suggests this "... highly productive industry displaying solid productivity growth ..." has a labour productivity that doubles the one in the US [29]. Construction has experienced significant growth partly due to expansion of mining and other natural resource industries (e.g. oil and gas) that evidently reflect their activities down the value stream and in both directions of the supply chains. Public consumption on infrastructures and buildings, as well as private consumption on homes, dwellings and construction related services drive the industry. Construction in general is one of the largest and most significant industries in Australia, contributing to economic growth and jobs (ca. 9% of jobs). In 2010, the industry was considered overall as the fourth largest industry in the country [2].

Globally, the construction industry seems to be undergoing the same digitization process as all the other industries. The possibilities are virtually limitless, covering the entire value chain of the construction process, starting from urban and land use planning and ending up with management of built environment assets. Automation of construction sites, digital design documents and design process and utilisation of Big Data each have their own characteristics, yet belong to the very same mega-trend. However, standards and best industry practices, as well as the fragmentation of the industry – comprising planners, decision makers, designers, architects, construction managers, developers, contractors, asset managers, facility managers, etc. – make this value chain a challenging environment for digital tools and processes to pierce through to become industry-wide accepted practices. Also the maturity level of application varies along and within the value chain. Whereabouts of the Australian Construction Industry in

## Digitization

One of the critical issues facing the Australian construction industry can be seen in the challenge of securing acceptable levels of efficiency and productivity [21]. Specific case studies and particular challenges related to, for example, construction's supply chains and adoption of new technologies, can be found in numbers (for example, [4,16,24,25]). The higher wage level in Australia, as compared to neighbouring countries, is constantly increasing the need for productivity research in construction projects. According to information provided from the Fair Work Ombudsman of the Australian Government [13], the 2015 national minimum wage in Australia was AUD \$656.90 per week (38 h).

The Australian Government's aim is for Australia to become a leading digital economy, which will contribute to Australia's productivity, maintain global competitiveness and improve social wellbeing by 2020. The Built Environment Industry and Innovation Council identifies that the increasing use of information technology will have a profound effect on the way the Built Environment is planned, designed, procured, constructed and operated [7]. Building Information Modelling (BIM) is one of the embodiments of digitization, adopting new technology and renewing processes as well as smarter ways of working when designing buildings and built environment assets. Not more than a decade ago, BIM was considered as a specialised tool for the industry [18]. Now, the integration of BIM and geospatial data is expected to produce a significant impact within the Australian construction sector. According to the SmartMarket Report from Ref. [23]; Australia is among the world's leading regions for adopting BIM, which have 49% of BIM users with more than three years' experience. Fig. 1 shows Australia and New Zealand compared to other major markets.

Other market reports find that accelerating the adoption of BIM in the Australian built environment sector could improve productivity by between 6 and 9% and adopting BIM for every participant in construction projects would increase 6 to 16% by 2025 [1]. This form of digitization is expected to produce an economic benefit equivalent to AUD 5 billion added to Australia's Gross Domestic product. Many Australian construction companies have started to invest in BIM processes and platforms. Fig. 2 depicts the priorities of investment according to a survey carried out by Ref. [23]. According to the respondents, 58% of BIM users in Australia prioritise the developing of internal BIM procedures, followed by developing of collaborative processes external to the companies (47%) and customising 3D design libraries (47%).

The Department of Industry, Innovation, Science, Research and Tertiary Education [7] recommends that the Australian Government encourage the State and Territory Governments, through the Council of Australian Governments, to fully commit to collaborative BIM, based on open standards which would be required in the procurement of their buildings. The drive for digitization is obviously present in Australia, both from the government and the construction industry. Whether this drive is reflected by the investment behaviour of the construction industry and how strong the drive is compared to other industries, is one of the key questions presented in this paper.

## 2. Aims and scope

This paper aims to assess how the Australian construction industry has kept up with the pace of digitization compared with other industries in Australia. We shall include some international comparisons although they are not the focus of this paper, but work rather as additional discussion threads and background. Our paper attempts to demonstrate with industry-comparative analysis how much the construction industry has been investing in ICT and

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