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An exploration of the concept of platform capitalism to better understand the political and techno-economic dynamics driving the digital transformation of architecture and construction.

Constructing platform capitalism: inspecting the political techno-economy of Building Information Modelling

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Architecture and construction are latecomers to the digital transformation that has taken hold in other industries in recent years. Presently, however, it is taking off fast, driven not least by government policies geared to encourage, support, and partly mandate the use of digital technologies in planning and construction, first and foremost Building Information Modelling (BIM). BIM still encounters considerable reluctance in parts of the industry, but also raises high hopes and expectations. BIM proponents, including governments, consulting firms, and the pertinent software producers, expect that it will reduce technical and managerial risks in the building process, strengthen transparency and collaboration among project partners, and improve the performance of buildings in various respects. Sceptics, mostly among architects and small- and medium-sized enterprises (SME), are concerned that it might entail a stratification of the market, for reasons we will return to in this article, and possibly a loss of creativity, autonomy, and relevance for architectural practitioners. In addition, proponents are promoting BIM as a gate-opener for further, advanced digital technologies and approaches such as robotic prefabrication, AI, drones, sensors, and the Internet of Things, which, in combination, will lead to a profound digital transformation of architecture and construction. In this article, we seek to achieve a better understanding of the political-economic dynamics behind this transformation: what are the driving forces? Who is likely to benefit and who is more likely to lose? What reconfigurations of actor and power relations can we see in these ongoing processes and how will they most likely affect the chances of developing a more sustainable, more environmentally and socially just building culture? For our analysis, we draw on in-depth interviews with architecture, engineering, and construction (AEC) professionals in Germany carried out in 2019 and 2020, along with document analysis and the literature on the digital transformation of architecture and construction. The document analysis mostly referred to Germany and the UK but also took international organisations into account. In order to assess the potentials, challenges, and implications of the ongoing digital transformation, we argue, it is important to take the socio-technical, economic and political dynamics into account that are driving it, intricately enabling and shaping each other as well as the power constellations they are embedded in. We examine these constellations and dynamics in light of the intersections of digitisation, datafication, and the current re-organisation of global capitalism, referring to the literature on platforms and platformisation,[1] assetisation,[2] platform capitalism,[3] surveillance capitalism,[4] data-driven,[5] digital,[6] or technoscientific capitalism.[7] The focus of this article is therefore on the larger political-economic and techno-economic conditions that are shaping the implementation of digital technologies in architecture and construction. We explore how the use of these technologies has affected architectural practices and reasoning, which we suggest holds implications for the fundamental meaning of architecture.[8]

The article, first, turns to critical political economic analyses of platformisation and platform capitalism and indicates how these apply to recent shifts and tendencies in the reconfiguration of actor and power relations in architecture and construction. Second, we briefly review some of the developments in digital architecture from 2D drawings to BIM and beyond. Third, we look into the role of governmental BIM policies as driving forces in the digital transformation and subsequently take a closer look at the case of software producer Autodesk and their BIM product Revit, which is moving towards a nearly monopolistic position in the world of BIM. This case illustrates how the logic of platform capitalism has gained traction in architecture and construction. We conclude that some types of actors – who are not exactly known for driving the transition towards a more socially and environmentally just and sustainable building culture – are likely to emerge more powerful from these shifts than others.

Architecture and construction in the age of platform capitalism

Modern architecture and construction are connected to capital and the transformations of capitalism in many ways, both directly and indirectly.[9] As David Harvey has shown,[10] channelling capital flows into the built environment has recurrently served as a temporary solution for crises of overaccumulation, often deployed by governments in order to maintain economic growth rates. Recent governmental efforts to push the digital transformation of architecture and construction, to which we will return below, might be viewed in light of this. Moreover, Harvey argues that the transformation of capitalist accumulation since the early 1970s – from a Fordist regime of standardised accumulation through mass production to a regime of flexible accumulation characterised by product differentiation and the increased significance of symbolic capital – co-evolved with postmodernist architecture and urban strategies to acquire symbolic capital through the production of built environments. Today, we see yet another transformation of capitalism, the formation of 'digital capitalism', co-evolving with transformations in architecture and construction. A common element of these transformations is the rise of the platform as its core and the associated data-based forms of production and accumulation.

Platform is an ambiguous concept that has been applied in different ways and different fields. Kenney, Bearson, and Zysman, for instance, distinguish between sectoral platforms, like Uber or Airbnb, operating in a single industry, and mega-platforms such as Google, Amazon, or Facebook.[11] Digital or online platforms can be understood as a set of digital frameworks for matchmaking, transactions, and social interactions between different parties, based on a technological ecosystem of hardware, software, and digital infrastructures such as servers, clouds, software packages, or financial services. Platform in this sense can be defined as 'programmable architecture designed to organise interactions between users',[12] including end users, corporate entities, or public bodies[13] that 'facilitate and organize data streams, economic interactions, and social exchanges between users.'[14] It is important to think of platform not as an isolated tool for performing certain activities but rather as an ecosystem including meta- and sectoral platforms, other types of companies, infrastructures, organisations, venture capital, and the relations between them.[15] The platform ecosystem is not a level playing field but structured by power differentials between different types of platforms including infrastructural platforms[16] or 'meta-platforms'[17] such as Google, Amazon, or Facebook.

Recent work in social sciences, science and technology studies (STS) and critical political economy has fleshed out the concept and shed light on the techno-economic nexus between the digital transformation and the ongoing reorganisation of capitalism which we can also observe in design, architecture, and construction. The rise of the platform as the core of digital capitalism was *not* the effect of technological innovation but the outcome of political decisions that endorsed the formation of the commercial Internet, the deregulation of finance, in combination with the US governments' voracity for behavioural data in 'the war on terror', and the reconfiguration of capitalism in response to the dot.com crisis in 2002 and the economic and financial crisis in 2007.[18] The outcome was an alliance of financialisation and platform economy,[19] with venture capital financing promising digital tech start-ups and information and communication technologies (ICT), enabling the proliferation of financial operations, actors, products, and markets.[20] Against this background, a new regime of capitalist production and accumulation formed around the beginning of the twenty-first century, based on information and communication technologies, digital networking and the econometric generation and processing of big data, with the commercial digital platform as its core model.[21] Digital platforms are techno-economic and cyber-physical arrangements whose algorithms enable, mediate, curate, structure, and constrain economic or social activities by bringing together different actors, such as producers, providers, users, and advertisers.[22] Although non-proprietary platform models are possible and some are existent,[23] the dominant type of digital platforms are proprietary platforms. Their primary model of generating revenue is not based on the production of goods for sale but on access fees, commissions, licences, lending fees, or brokering the products of others. Simultaneously, they generate revenue from extracting, structuring, curating, analysing, and transferring data generated by their users. In this sense, platforms operate as assets understood as structures for extracting economic rents.[24] For instance, like most contemporary software solutions, BIM is no longer purchased but licensed, thus operating as an asset that yields a continuous rent for its owner, including for instance BIM software Revit by Autodesk.

Platform economies tend to be based on a type of good defined by infinite scalability, non-scarcity, low transaction costs, and ease of distribution – such as BIM planning tools. Most importantly, platforms expand through self-reinforcing network effects resulting from the fact that as the attractiveness of a platform increases the more users it can retain, the more services or products it can offer and the less users have to step outside the platform 'universe'. Thus, platform firms strive to win over as many users as possible and lock them into their system, for instance by offering all-in-one solutions or impeding interoperability between their native products and those of other producers. Consequently, switching becomes increasingly costly and risky as it is accompanied by a loss of contacts, networks, and know-how. The result is an expansive winner-take-all logic with an immanent tendency to form monopolies, pushed further through aggressive acquisitions beyond their original domain, and the creation or takeover of digital infrastructures, such as applications, clouds, pay services, or currencies. A further characteristic is the tendency of platform firms to enter the 'old' economy and challenge incumbent firms through disruption.[25] In this vein, a number of big tech companies are investing in modular construction. Modular construction, also referred to as off-site construction or prefabrication, involves producing standardised building components and modules in an off-site factory and their assembly on-site, often combined with robotic automation. Google and Facebook along with Autodesk, for instance, invested in off-site construction firm Factory_OS,[26] and Google/Alphabet Sidewalk Labs launched Delve, a generative design tool[27] powered by machine learning for urban development.[28]

A brief glance back: from 2D drawings to data-generated modelling

Since the early 1980s, digital technologies have been an integral part of architecture, engineering, and construction (AEC) work. Robert Aish, who critically contributed to the development of Building Information Modelling, distinguishes four phases in the evolution of architectural computing going from: (1) computer-aided 2D drafting via (2) conventional BIM producing 3D models for the extraction of 2D drawings; (3) design computation as BIM generator, with the architect creating scripts or graph node diagrams with which to generate a BIM model; and finally (4) analytical models linked directly to fabrication data driving automated fabrication processes.[29] The progression is often illustrated as one from 2D CAD drawings to 3D BIM models.[30] While this progression might reflect the adoption of leading software applications in each category such as from Autodesk's AutoCAD to Revit, thus suggesting that one followed the other, it obscures their mostly concurrent development and different purposes. Strongly interlinked in their software development processes, CAD and BIM follow different approaches to design as few historical studies reveal.[31] Admittedly, more empirical studies of how architectural practice is being shaped with the ongoing transition from CAD to BIM as well as from AutoCAD to Revit and similar are needed. In this article, however, we focus on a few limited aspects related to the reorganisation of design practice and the CAD-BIM historical trajectory that are pertinent for providing a better understanding of their constituent political-economic dynamics.

AutoCAD, with its direct translation of the 2D draft table into computation became the leading application for the creation of 2D drawings in architecture, civil engineering, and manufacturing. The result, however, was 'flat drawings that contained no or little additional "intelligence" or semantic information, that were unrelated to each other.'[32] The second generation of AutoCAD and similar tools were then enhanced with a 3D kernel to allow for 3D modelling.[33] Unlike CAD with its primary application in the creation of 2D and 3D perspective drawings, the BIM approach to design and its translation into software applications focuses on the creation of 'information-rich construction elements as building blocks'.[34] ArchiCAD, by software developer Graphisoft, for instance, is often credited with leading the transition from data-poor 2D CAD drawings to the data-rich 3D representations in models with parametrically connected elements and the corresponding construction information.[35] Also, unlike CAD, BIM performs not only as a design tool but as a market place that offers an interface to digital model repositories where the architect can 'shop' for materials and specifications. The leading specifications repository in the UK, NBS, acts as a platform that enables transactions between product manufacturers, architects, contractors, and other users. NBS, in turn, has a close relationship to leading software companies, above all Autodesk. In a sense, thus, BIM situates the architect in the position of a shopper clicking through the range of articles offered through the platform.

Besides data generation, information management, and market transactions, BIM enables collaboration through 'data-sharing and communication across the organizational boundaries and in the intended collaboration encoded into the software'.[36] As Daniel Cardoso-Llach notes, '[d]ifferent from a conventional CAD model, this simulation combines the contributions of multiple organizations.'[37]

With data-generated 3D building models, not only the result but also the process of design iteration is represented and stored in the model; the representation takes the form of an 'editable, re-executable design history'[38] that can be rewound and reworked several times in different ways, each time leading to a different project-related result. Data-generated BIM represents the digital convergence of a 3D building model, a database including information about geometry, components, costs, and simulations, and an interface for multidisciplinary collaboration. It allows the extraction of large amounts of data on construction costing, site- and object-specific use of materials, collaborative relationships, as well as individual participants' operations. Thus, in data-generated BIM, both semantic details of the model, results of design work as well as the operations performed on the model take the form of data that can be extracted, rearranged, exchanged, reused, and transferred to further projects and actors. 'As the adoption of BIM grows', Yue Pan and Limao Zhang project that 'the amount of BIM data will increase exponentially, resulting in some characteristics of "big data".'[39] Zhang and Ashuri have shown that it is possible to extract log data of individual users of the model and assess collaboration processes among the user group as well as individual users' performance.[40]

BIM is a socio-technical innovation that both enables and requires new forms of organisation, communication, workflows, contracts, remuneration, and more. It profoundly changes the nature of the design process, since, as Aish puts it, 'it reverses the natural order of the architect's design process and forces the architect to think about the design or the selection of the components before the overall form of the building has been explored.'[41] Whereas, previously, decisions about materialities and forms were left to designers' experience and expertise, now product libraries placed by financially strong construction companies define the scope of design options. As the range of project parties as well as the types of data to be generated, processed, and stored are expanding to include maintenance, facility management, and demolition, BIM is evolving more-and-more from a modelling medium towards a management tool for the built artefact. BIM's visual shift from speculative renderings to a spreadsheet aesthetic based on construction components and data validates design decisions made on a numerical ground 'in boardroom discussions around economic policy and project viability'.[42] In parallel, issues of software interoperability and common standards, digital infrastructures like servers and cloud services, and the question of who controls these becomes ever more critical.

The translation of construction knowledge into 3D models facilitates the potential for robotic fabrication and automation and BIM is supposed to act as a facilitator for the use of further computer-based technologies such as wireless sensors, augmented reality, and 3D printing. In the UK, BIM is imagined to act as a gateway technology to the creation of a national digital twin structure, a digital ecosystem for the modelling of physical assets that is supposed to act a resource for data sharing and value creation.[43]

BIM: promises and policies

The adoption of BIM is strongly promoted by governments. The last few years have seen a proliferation of policy programmes, strategy papers, conferences, analyses, and reports in various geographies and produced by a variety of actors, such as associations of architects, software providers, consulting firms, governments, international governmental, and non-governmental organisations. A recurring storyline, prominently featured by governments, consultancies, the EU, and the World Economic Forum (WEF) goes like this: The building industry is notoriously fragmented, traditionally oriented, and adverse to innovation; therefore, its productivity has stagnated for decades. It is lagging behind other industries with regard to digitisation and automation. Yet, its growth potential is enormous, due to a growing world population, urbanisation, and an aggravating housing crisis. Concurrently, the construction industry is a major source of global waste and CO2 emissions. Digital technologies are positioned with the potential to solve this plethora of problems, thus architecture and construction have to maximise the use of data and digital models in order to manage these challenges.[44]

A key role in this storyline is assigned to BIM, presented as a panacea for tackling all the major ills afflicting the industry. It is supposed to foster cost efficiency, reduce risks, speed up project delivery, smoothen the workflow, ensure transparency, and establish relations of partnership and collaboration between clients, architects, engineers, construction firms, subcontractors, and public authorities. Many governments have adopted this story and set up policy frameworks for encouraging, enabling and partly mandating the implementation of BIM.

With regard to construction, governments act in various capacities: as major clients of construction projects, in particular large-scale projects, as promoters of national competitiveness, and as regulators and policymakers. In their capacity as clients, they see BIM as an instrument to better control risks, improve time and cost efficiency as well as quality and performance of public construction or infrastructure projects and to optimise project management and admission procedures. In their capacity as promoters of the national construction industry, they see it as a means to increase its productivity and competitiveness in global markets. As regulators and policymakers, governments can prescribe the use of BIM for various segments of the construction sector or support it through various measures. They play a critical role in creating the conditions for a general diffusion of BIM, be it through guidance, regulatory frameworks, mandates, training programmes, or common standards for interoperability of software solutions.

By now, many governments around the globe have embarked on policies encouraging, promoting, enabling, funding, or mandating the use of BIM. In 2017, a study sponsored by the Ireland-based Construction IT Alliance reviewed the status of BIM in 27 countries, finding that over half of them had regulatory requirements for BIM or were planning to implement them, and two-thirds had issued BIM guides or manuals for facilitating its application.[45] At the time, eleven out of the twenty-seven countries reviewed had some form of mandate in place, requiring the use of BIM for certain types of construction projects.[46] For instance, in Denmark, BIM was obligatory for government offices and university buildings, in Russia for all federal orders, in Singapore for buildings larger than 5,000 sqm, in the UK and the US for all government projects. Several other countries had planned to introduce a BIM mandate for the near future, such as Chile, France, Peru, or Spain. In Germany, the 2015 Road Map for BIM by the Federal Ministry of Transport and Digital Infrastructure stipulates that BIM be applied on all new public projects procured in Germany from the end of 2020 onwards.[47] A range of further countries have adopted programmes and strategies for developing and managing common standards and guidelines for the certification and execution of BIM projects and established government agencies to facilitate its implementation.[48]

The UK is often held as one of the most advanced countries regarding BIM adoption. In 2011, the UK BIM programme proclaimed that all public sector construction projects require the use of so-called Level 2 BIM[49] by 2016.[50] In 2012, the BIM Task Group was formed as a joint government and industry working group to support the adoption of BIM Level 2, later on, in 2017, replaced by the Centre of Digital Built Britain (CDBB). In 2013, the government launched its industrial strategy *Construction 2025*, proclaiming a vision for 33 per cent lower construction and life cycle costs, 50 per cent faster delivery, 50 per cent lower greenhouse gas emissions and 50 per cent increase of exports in UK construction by 2025 through the implementation of BIM.[51] It was followed by the Digital Built Britain strategy in 2015,[52] and flanked by a broad communication strategy.[53]

On a supra-national level, the EU Procurement Directive of 2014 (EUPPD) encouraged EU member states to require the use of BIM for public works contracts and design contests by mid-2016. In 2016, the EU BIM Task Group was established as an association of large public procurers, policymakers, and public estate owners in Europe to create a common network for using BIM and develop a common framework for the exchange of digital information based on open standards. The Group was co-funded by the European Commission for two years (2016–17). In 2017, it launched a handbook that provides guidance for public procurers when introducing BIM.[54] Environmental objectives are mentioned only once and in passing as '[a]dapting to a sustainable built environment – one that supports the challenges of climate change and the need for a circular economy.'[55] The policy objectives are clearly increased productivity, sector growth, faster production, better value for public money, and 'an open, competitive and world-leading digital single market for construction.'[56] However, the EU BIM policy has also raised concerns about related market concentration processes. In 2020, the European Construction Industry Federation (FIEC) complained to the EU Commission that a

> *few software providers have come to dominate the global market for construction related software and services, in particular around BIM. This has led to distorted competition on the EU market as well* [...] *these dominant providers are locking in their construction clients to unfavourable agreements.*[57]

The FIEC calls on the EU to take effective measures to prevent the formation of such monopolies. Whether this will actually happen, remains to be seen.

Oftentimes, digitisation policies for the construction sector were championed by an industry-led initiative of larger planning and construction firms and software producers; in Germany, for instance, by *Planen-Bauen 4.0*, in Finland by the Confederation of Finnish Construction Industries, in Hong Kong by the Real Estate Developer Association, in the UK by the Construction Industry Council. In nearly all countries reviewed by Hore, McAuley, and West,[58] BuildingSMART international or one of its regional chapters were involved. BuildingSMART international is an alliance of companies, government bodies, and institutions founded it 1995 that promotes the use of open (not to be confused with non-proprietary) sharable building information through developing and maintaining the Industry Foundation Class (IFC) platform. IFC defines a major, global, open standard for data exchange in the construction industry and thus a major basis for interoperability between different BIM and CAD software. The software producer Autodesk has been an original founder and is now member of its Strategic Advisory Council, together with software solutions providers Nemetschek Group and Trimble, multinational corporations Siemens and ARUP, and China Railway BIM Alliance and China Communications Construction Company.[59]

On a global level, the Global BIM Network was established in 2021. This network of public and private sector representatives and multilateral organisations are building a collaborative framework to advance the knowledge and capacity of national policies and programmes. Within the Network, Andrew Friendly, vice president of Government Affairs and Public Policy at Autodesk, leads 'a global team advancing policies to support Autodesk's business'.[60]

In short, many governments have pushed to make BIM a standard in order to reap the promised benefits of building: basically more, faster, better, and cheaper. Consequently, BIM becomes an obligatory point of passage,[61] forcing all parties involved to adopt its rationalities, pushing and enabling particular ways of practicing design and construction while potentially foreclosing others. Whether, and for whom the promised benefits actually materialise remains to be seen. Some policy programmes mention a concern about high upfront investments and the need for governments to secure an equal playing field so that small- and medium-sized enterprises (SME) do not lose out to large corporations. Whether, how and to what effect this is actually done, however, is not clear. Andrew Dainty and his co-authors have shown for the UK that, despite repeated claims to take SMEs' concerns into account, the government does not specify any policy measures to do so.[62] Whether the same holds true for BIM policies in other countries is a matter of further research. There is evidence that SMEs are more reluctant to adopt BIM than bigger firms. While a series of surveys and studies on the uptake of BIM in architecture and construction conclude that BIM adoption, or at least intent to do so, has grown over recent years, they also show that a great share of respondents, in particular SMEs, still see multiple issues and impediments, with the cost of investment, the lack of training and expertise, and the excessive amount of time afforded ranking at the top. Also, these surveys constantly show that adoption rates are higher among larger companies than among SMEs.[63] The result might be an increased stratification of the market with small-sized architectural studios – which is still the majority of studios in Germany, the UK and many other countries – losing out to a few global 'starchitect' firms or to big construction companies with in-house architects, as one of our interviewees was concerned:

> *Then* [company name] *and whoever else will come out with their design-build concepts, and then they've got the high-rise project in their pockets, they've got their architect sitting there, s/he runs a script, makes three suggestions, window this big, window this big, window this big, and then really just presses the button – that's*

possible with this software. This generative development design, it's crushing us.

As a result, heavy investments make most sense either for large, complex projects for major clients that could not be realised without sophisticated technology, or for serial solutions where economic returns can be generated through scaling.[64] One effect of the digital transformation, therefore, might be the concentration of construction projects within these two segments, with little incentive to build non-serial, aesthetically attractive, high-quality buildings that are also affordable at moderate costs.

Another aspect that requires further investigation is whether the generalisation of BIM actually contributes to a reduction of waste and CO_2 emissions. While a number of programmes, plans, and reports mention the *potential* of BIM to do so, at least for Germany, the UK, and the EU, it is not clear how this potential gets realised and what, if any, provisions for securing and monitoring shall be installed.

Throughout the strategy papers, plans, and reports we analysed, there is a rhetoric of transparency, integration, partnership, of interaction, and collaboration on equal footing that benefit everyone. When we look at the reconfiguration of actor and power relations, we can see a less idyllic picture of new dependencies and increasing concentration of economic power.

'For the fear of commercial reprisals': the case of Autodesk

A key role in disseminating BIM and spreading the principles of digital capitalism in the AEC sector has been assumed by software company Autodesk, especially through its BIM product Revit and its more recently launched BIM-based cloud solutions. Several companies and research laboratories have been involved in the nearly forty years of development, but BIM's popularisation and broader dissemination are significantly defined by Autodesk and Revit. As another interviewee, an architect and structural engineer working for a renowned international engineering office, told us: 'when people say BIM, three-quarters of them mean Revit.'

Autodesk acquired Revit in 2002,[65] and turned it into a '$20 billion industry standard today in BIM'.[66] Since then, it has come to hold a dominant position in the global market and increasingly defines digital formats, interfaces, and standards for 3D building models around the world. Although not a meta-platform like Google, Facebook, or Amazon, Autodesk has turned Revit into the prime BIM platform and locked in the majority of BIM users worldwide. Exact numbers are hard to obtain, but anecdotal evidence suggests that as much as 90 per cent of US and 80 per cent of UK firms working with BIM use Revit.[67] A survey among mostly UK-based firms found that 50 per cent of respondents used Revit.[68]

With their *Construction Cloud Connect* and the *Forge* platform, both combined cloud-application programming interface (API) solutions, Autodesk bridges companies, processes, and data. At its 2020 conference, the Autodesk University, it announced a push towards a one-stop AEC cloud solution by investing in the development of the Revit API and Autodesk Forge, a cloud-based software development platform, as their primary future strategy.[69] The need for interoperability of data models for project partners to this standard decreases the chances for architects to employ non-proprietary software applications. Even if they do, Revit remains an obligatory passage point for many, as a computational designer explained to us:

Yes, we are forced to use Autodesk products as well. However, we do not work with it. We work partly with it by creating interfaces. [...] *we have developed an interface so that we can completely model things in Rhino with the requirements for Inventor* [Autodesk manufacturing design software]. *And then we programmed an interface so that the data is automatically sent to Inventor and the finished product is fed back. And of course, we have written such interfaces to several software* [applications]. *So, also to Revit.*[70]

Although further research is needed to substantiate these observations, we can observe a series of moves and strategies enabled by specific technoeconomic arrangements that show an inherent tendency towards concentration of economic power. While these apply to the functioning of BIM in general, they have been deployed by Autodesk so successfully that they have gained a nearly monopolistic position in the world of BIM. These moves and strategies start from offering software solutions for collaborative work in project design, management, and construction and integrated interfaces for digital object libraries where third-party manufacturers and subcontractors offer their services or building components for purchase, thereby establishing a proprietary market place for the construction industry. Simultaneously, these arrangements allow for generating and gathering design, construction, and collaboration data via software logs and cloud connections that can be exploited for secondary use and turned into rent-generating assets.[71] BIM tool producers can also offer data analysis and evaluation that can be fed back into design and planning and thus facilitate design automation in general.[72] As regards economic strategies and commercial models, key moves are the aggressive acquisitions of promising start-ups in and beyond their domain, particularly in construction,[73] a switch from product licenses to subscription models, advancing interoperability between its own products while inhibiting interoperability between its products and those of competitors, and a concentration of investment in construction and digital infrastructure, such as clouds.[74]

Many of these moves came up recently in an unusual case of collective action of 'Architects versus Autodesk':[75] In 2020, a group of influential UK-based and international architectural firms launched an open letter to Autodesk's CEO Andrew Anagnost *[1]*.[76] The architects protested against the costs of Revit, particularly the switch from a purchase model to annually increasing subscription fees. The switch meant that users require a license payment for a

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AECMAGAZINE

Open letter

To: Andrew Anagnost, President and Chief Executive Officer, Autodesk

Subject: An open letter that reflects customer perspectives on Autodesk in 2020.

Industry Context

The RIBA (Royal Institute of British Architects) Chartered Practice Benchmarking Report highlights the increasing cost of ownership of design-based software as part of the overall growth in costs that the design industry is facing. Even before the Covid-19 pandemic costs were under significant scrutiny and the value added by software vendors is now being questioned as never before.

It is in this context that a number of practices, who represent a revenue stream for Autodesk of over $22m over the last 5 years and thousands of users have come together to express their concerns in a survey which was carried out in June 2020. Their concerns relate to the increasing cost of ownership and the operation of Autodesk's Revit software and fundamentally its lack of development.

In the period between 2015 and 2019 most practices who participated in the survey have had at least 5 different licence models in play, moving from individual product licences, to suites, through to collections and now, in 2020 to individual user licences. Overall, those surveyed have seen costs increase up to 70% and beyond to the end of 2019.

Practices would be less worried by these cost increases if they were mirrored by productivity improvements and a progressive software development program.

Where once Autodesk Revit was the industry enabler to smarter working, it increasingly finds itself a constraint and bottleneck. Practices find that they are paying more but using Revit less because of its constraints.

Computing Context

Every day digital design leaders around the world wrestle with software which at its core is twenty years old and incapable of the potential of multi core computing and graphics power designed to process within today's real and virtual workstations. Project productivity in architectural and engineering practices is hit daily because of the lack of scalability and product performance, which then require sophisticated and practice specific 'work arounds'.

(Question 2).
Most practices think that the platform is not meeting current industry requirements.

(Question 3)
Autodesk has tabled a variety of initiatives for the next generation of tool(s) to replace Revit but failed to prioritise investment and failed to communicate the roadmap for the delivery of a viable platform to users.

(Question 8)
Cost increases on existing software portfolios continue but little value is added to create improved productivity in the core product for design practices in the industry.

Project design outcomes thrive on ever-increasing collaboration between different design disciplines requiring many forms of data interoperability between software platforms as well as compliance to international data standards.

Greater collaboration on interoperability between software platforms and providers could lead to a larger market for all, given the industry is on the cusp of a 'design for manufacturing' revolution. (see McKinsey & Company "The next normal in construction - How disruption is reshaping the world's largest ecosystem").

Designers are in a continuous mode of innovation and improvement as they recycle and evolve data between an ever-expanding portfolio of applications. It is essential to effect better interoperability between Autodesk products as well as with the rest of the industry.

Organisational Context

Microsoft's reinvigoration under Satya Nadella and his focus on a growth mindset and cultural change is exemplified by this quotation:

> *"First we needed to obsess about our customers. At the core of our business must be the curiosity and desire to meet a customers unarticulated and unmet needs with great technology. There is no way to do that unless we absorb with deeper insight and empathy what they need."*

(Satya Nadella - Hit Refresh - The quest to rediscover Microsoft's soul and imagine a better future for everyone. page 101).

This approach would be hugely appreciated by the design community. However, there does appear to be a lack of trust and empathy from practices regarding the use of Autodesk's cloud services.

(Question 9).
Cloud services must be an area of potential future expansion for design businesses as well as for Autodesk as a provider. However, trust, empathy and respect need to be at the core of any such future business relationship.

The protection of intellectual property will be at the centre of the debate for cloud based common data environments. Users want to know what any data that resides in the Autodesk cloud is going to be used for beyond individual project collaboration. Further the robustness and performance of the Autodesk cloud platform remain a cause for concern.

It is important to note that not all practices felt comfortable adding their name to the list of signatories to this letter for the fear of commercial reprisals but have added their revenues and user count as support for this initiative. Fear, real or perceived in what should be a positive relationship with a key software provider illustrates that there are issues that need to be addressed in Autodesk's powerful relationship with the industry and the industry's relationship with Autodesk's sales structure and processes.

(Question 5)
It should be noted that most organisations record a positive relationship with the technical and product support teams in Autodesk.

The Future

The practices involved in this initiative seek from Autodesk a transparent action plan that is customer centric, non-adversarial, innovative, progressive, and deliverable that includes:

A vision, roadmap and investment strategy that targets adding value and performance for design based organisations that prioritises the replacement of Revit from the ground up to reflect the functionality needed for a 21st century digital industry.

- A commitment to continuously improving application, and industry interoperability (including IFC) as well as expanding geometry support and alignment to international data standards.
- Engagement to build a cultural partnership with all customers based on trust, empathy and respect.
- A proposal for cost stability.
- Research and development commitment that is, focused on the needs of the global design community.

From -

A community of national and international design practices including:
AHMM | Allies and Morrison | Aukett Swanke | BVN Architectural Services | Corstorphine + Wright | Fletcher Priest Architects | Glenn Howells Architects | Grimshaw | PRP | Rogers, Stirk, Harbour and Partners | Scott Brownrigg | Sheppard Robson | Simpson Haugh | Stephen George + Partners | TTSP | Wilkinson Eyre Architects | Zaha Hadid Architects

If you feel you would like to add your practice to this letter and be included in the response from Autodesk.
Please Contact - **enquiries@godwinconsulting.net**

July 2020

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1 **The open letter to Andrew Anagnost, President and Chief Executive Officer, Autodesk, published by AECmagazine in 2020.**

particular time – in Revit's case, from one month to three years. If an architect or engineer ties their license to a particular project, they might be unable to access this data and reuse it for further work. Access to prior data and models resides with the platform owner.

Coming back to the proliferation of BIM policies, it could be added that, in the situation of a near-monopoly of Revit on the one hand and the proliferation of governmental BIM mandates on the other, the costs of Revit become the entrance fee for architectural firms to bid for major public contracts and thus exercise influence over who can access this market and who not.

Furthermore, the architects in the Open Letter complained that little value was added in the software for design work. Instead, they say, the revenue generated from architects' licensing fees get invested mainly into products oriented towards the more profitable construction software market. Similar complaints had already been raised by architects from Australia and New Zealand in 2014, but not published at the time.[77] The group additionally demanded that pursuing new market segments such as building contractors should not be done at the expense of further development of the architecture tool – Revit – they are paying ever rising fees to.[78] Autodesk, it seems, invests the revenue generated by Revit into developing their Construction Cloud, a cloud-based infrastructure for automated construction and off-site prefabrication.[79] Presumably, the emerging market for such cloud solutions will exceed the market for design software. Further matters of concern named in the Open Letter were better interoperability between Autodesk products with the rest of the industry and the protection of intellectual property in the context of cloud based common data environments: 'Users want to know what any data that resides in the Autodesk cloud is going to be used for beyond individual project collaboration.'[80] Not least, the Open Letter tells us:

> *It is important to note that not all practices felt comfortable adding their name to the list of signatories to this letter for the fear of commercial reprisals but have added their revenues and user count as support for this initiative.*[81]

Whether this incidence indicates the emergence of a new type of unionising in face of platformisation and digital capitalism remains to be seen. In any case, it may illustrate that assessing the implications of the digital transformation in planning and construction requires looking beyond the risks and benefits of individual technologies and take the larger technoeconomic power dynamics into account.

Conclusions: emerging implications of platform capitalism in the world of planning and construction

By now, Autodesk and Google have both expanded into the business of urban design. In November 2020, Autodesk acquired the Norwegian technology start-up Spacemaker for $240 million. It was its fifth acquisition of a preconstruction solutions provider in three years.[82] Spacemaker is a cloud-based artificial intelligence-supported software for urban development that promises to deliver the 'best possible' urban planning solution for a site through quick iteration of design options along specific input criteria.[83] Autodesk proclaims it helps to 'maximize developers' long-term property investments and realize the full potential of the site',[84] to increase project value, as well as the ability to consider sustainability options. Shortly before, Alphabet subsidiary and Google sister Sidewalk Labs launched Delve, a similar generative design tool powered by machine learning for urban development.[85] Notably, the algorithms for these tools can only operate and be trained with *available* data, much of which is coming from the use of proprietary BIM software. Thus, data are primarily made available to the companies owning the software. Given these are only a handful of software and Big Tech companies, this means that the general adoption of BIM – that many governments are aiming for – will considerably increase the influence and decision-making power of these companies in the fields of design, construction, and urban planning.

Hence, the logic of platform capitalism is beginning to transform the AEC industry, with BIM acting as an obligatory passage point and government policies as gate-openers. The implications for the built environment are not yet fully visible today. Governments tend to highlight BIM's enormous benefits in terms of increased productivity, efficiency, competitiveness, and economic growth in line with reduced costs, improved quality, more value for public money, as well as lower CO_2 emissions and less waste production. Whether these benefits will actually materialise in equal measure or whether the imperative of building ever more, cheaper, and faster will prevail over environmental sustainability is currently hard to tell. To the best of our knowledge, there are not yet studies that show the actual impact of BIM mandates on economic concentration processes, their implications in terms of an environmentally sustainable building culture, or the delivery of liveable and affordable housing. Also, the capacity to 'automate' design through generative tools may offer extended possibilities of visualisation and collaboration, but whether this gives more weight to the needs of citizens and inhabitants or to the interests of real estate owners, developers, software producers, and Big Tech companies, is a matter for further investigation. While it is undisputed that BIM *can* be used to deliver on these goals, it is less clear to what extent it actually does and whether BIM policies have made a difference in this regard.[86]

We can, however, recognise a number of technoeconomic moves, shifts, and tendencies bound up with this transformation that will most likely affect who will gain, who will lose, which implications this is likely to have on the building culture. In the realm of design software, this reconfiguration includes a further concentration of economic power with the tendency towards a near-monopoly by software provider Autodesk, further stabilised by securing control in the realm of cloud infrastructures and interoperability standards and a shift of focus and investment from architectural design to software solutions for construction and urban development, benefiting primarily real estate owners, investors, developers, and construction companies. Furthermore, we can expect large construction firms to act as early adopters, securing themselves a comfortable starting position in a first-mover-takes-the-most game at the expense of SMEs facing bigger challenges to benefit from the implementation of BIM, and the encroachment of tech giants and hitherto domain outsiders such as Alphabet into architecture and construction, turning buildings and cities into machines for data extraction. In the long run, BIM's techno-economic reconfiguration of AEC, the use of data, rise of platforms, and increasing standardisation are likely to have similar implications for its practitioners and the broader society alike, as has been extensively observed in other societal domains reconfigured by data, algorithms, and platforms.[87]

Thus, we see types of actors benefiting from the ongoing techno-economic shifts that are not exactly known for prioritising environmental sustainability, affordable housing, or more liveable cities over data extraction and their own economic profit. Again, the actual implications of all this require further research. The purpose of this article was to draw attention to the amalgamation of technological, political and economic power relations and reframe the problem of BIM and the digital transformation of architecture and construction as one of platformisation and digital capitalism. Without accounting for the logic of platform capitalism, BIM policies will most likely, even if unwillingly, facilitate platformisation and assetisation in architecture and construction and in the future also urban planning. The severe challenges posed by the environmental crisis and the need to provide adequate and affordable housing are likely to rank second. It would be worthwhile to study the respective policy processes and see whether policy actors are problematising the potential social and environmental risks and side effects of the BIM policies they are promoting. In any case, it is mandatory to critically interrogate the digital transformation in architecture and construction in light of the technoeconomic dynamics and the reconfiguration of power relations it is enmeshed with.

Notes

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Competing interests
The authors declare none.

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