2018 SOCLA CONFERENCE
Technological Developments:
BIM is vital for the future, but industry must co-operate

Chris Lenz[1]

A. Introduction

The seeds for this paper were sown in 2014, when the author discovered Building Information Modelling ("BIM"). Our construction industry needs to change the *status quo* of low productivity, marginal profitability, costly disputes (often resulting in insolvency), and significant delays. The *status quo* was not new, but apparently BIM could offer some solutions.

This research found that many other writers have recognised BIM may be a solution. Therefore, this paper assimilates and synthesises some of the published ideas, research and recommendations to assist construction lawyers and other industry advisers ("construction advisers") to engage with BIM. It examines BIM at a strategic level and analyses some of its components to briefly explain some aspects of the process. For many of those who already understand BIM, it may provide some assistance in understanding the need to draft BIM friendly contracts.

It was considered important to properly lay the foundation for the paper which meant that the headings *Productivity* and the *BIM Explanation* of necessity, were more extensive, so that it could be appreciated that the current status of the industry (being the field) and the plant (being BIM), being watered by collaboration could provide a good yield.

In a sense, the paper is "a call to arms" for construction advisers to take the lead and overcome the current inertia, where industry is expecting leadership from government, and government needs time to do so, whilst requiring industry involvement. In an environment where disruption from technology is pervasive throughout the entire economy, a "wait and see" response from the construction industry appears logical, because participants do not want to unwisely invest and "back the wrong horse". However, the paper suggests that this is inappropriate and that the construction advisers must be proactive and lead.

Learning and understanding new technology and processes in a fast-moving world is difficult, because benchmarks keep changing, and BIM is no exception. Nevertheless, the time has come for all construction advisers dive in and learn about what BIM is, and what it can do. Procurement of and management of projects must be carried out on a collaborative basis to maximise the benefit from BIM to all participants.

Naturally there will be mistakes and incorrect decisions made on this journey, in a rapidly changing environment, but the lessons learned along the way will ensure that the industry understands there is "a better way of doing business". Those who profit from inefficiency will lose, but for the rest of us, we will benefit from making the change.

[1] Chris Lenz BSc(Eng) LLB(Hons) MBA LLM *Redstack BIM Management Certificate 2017* Solicitor

B. Approach taken in this research

The paper considers:

1. The poor *productivity* of the industry, not only in Australia but worldwide, and some of the reasons why, and the current disruption to the poor productivity *status quo*.
2. BIM's adoption in Australia.
3. What BIM is, and its involvement with this disruption to illustrate why it assists to change the *status quo*.
4. The current contractual regime in Australia.
5. BIM's overriding *need for collaboration*
6. Whether these amended contracts provide for collaboration.
7. Whether the US and UK *protocol* approaches of appending a *protocol* to the unchanged construction contracts thereby facilitates the necessary collaboration.
8. A theoretical risk scenario from the BIM process.
9. Finally, that a new contractual approach is required to encourage, facilitate, and (perhaps) force participants to properly negotiate agreements to successfully deliver a project.

C. Productivity

Procurement of construction services is often based on the cheapest price. The issues from these words echoing 9 years ago may sound familiar:

> *"The low penetration of cultural change has been exposed by the current economic downturn, with evidence that clients and main contractors are now reverting to type (if they were ever committed to partnering the supply chain in the first place)..... select on the basis of lowest price.*
> *We are seeing a return to long tender lists, firms chasing work at unsustainable margins, cost and time overruns, jettisoning of quality or sustainability initiatives and more of a claims-oriented approach..[2]"*

Wolstenholme and others confirm the *cheapest price option* is pervasive. Given the productivity malaise identified below, it probably infects the entire supply chain from client, designer, constructor (and its subcontractors and suppliers), and other consultants. This is unsustainable, and yet the *status quo* remains in breach of the principle "*The common law of business balance prohibits paying a little and getting a lot - it can't be done."* John Ruskin (1860).[3]

This *status quo* is very inefficient. For example, whilst the Australian construction industry, in 2015-6 contributed 8.7% to GDP,[4] worldwide it is an industry that is the second most unprofitable industry after retail [*Economist*, citing *Mckinsey*[5]]. The *Economist* added that the industry's global productivity in the last 20 years averaged 1 percent, compared to 2.8 for the total world economy and 3.6% for manufacturing.

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[2] Andrew Wolstenholme: *Never Waste a Good Crisis*: A Review of Progress since *Rethinking Construction* and Thoughts for Our Future, Constructing Excellence in the Built Environment, (2009) Constructing Excellence, London, Key Blocker: Delivery model, page 19

[3] cited in Sir John Eagan: *Accelerating Change*, a report for the Strategic Forum for Construction, London, Contents, page 3

[4] http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/5204.0Main%20Features22015-16

[5] Economist: Thought Leader 19 August 2017

The *Economist* reported that it was an industry that raised prices for clients and mostly ignored tools that might improve productivity. It quoted Ben van Berkel, a Dutch architect who said, "While we are all using iPhones, construction is still in the Walkman phase[6].

McKinsey added in July 2017 that *construction appeared to be stuck in a time warp* and one reason was mismatches in *risk allocations* and rewards.[7] The *time warp* resonates with van Berkel's iPhone/Walkman dichotomy, and illustrates an inability to adopt a disruptive way of doing business.

The *McKinsey Global Institute report's*[8] considered by the *Economist* above identified 7 levers to fix construction's productivity problem, suggesting a new approach was required from all players. These were (with the author's emphasis):

1. reshaping regulation and raising transparency;
2. **rewiring the contractual framework**;
3. rethinking design and engineering processes
4. improving procurement and supply change management;
5. improving on-site execution
6. **infusing digital technology, new materials, and advanced automation**; and
7. reskilling the workforce in which *collaboration* was the key.

Industry may well argue, "Why change?", or "What's in it for me?" *McKinsey* reported that if construction productivity caught up with the total economy, it would boost the sector's value by an estimated $1.6 trillion adding about 2% to the world economy, **or the equivalent of meeting about half the world's infrastructure need.**[9] Of course most participants, apart from Government, want a direct tangible benefit, not some vague benefit to the whole economy.

However, stakeholders worldwide recognised that the industry was on the verge of *disruption*, and industry players were actively working on new approaches.[10] These approaches included:

1. incremental approaches using small discrete programs;
2. transformational agendas designed to work within the current confines of industry;
3. making significant strategic bets to radically restructure the value chain.

The authors continued that it was not clear which approach would win, but they said **understanding the challenge and the opportunity to address it is the first step**.[11]

This paper suggests the *first step* should be taken by construction advisers with the challenge to provide two of McKinsey's 7 levers:

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[6] Economist: The construction industry, *Least Improved,* 19 August 2017, page 50

[7] Barbosa, Filipe; Jan Miske and Matthew Parsons: *Improving Construction Productivity*, July 2017 https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/improving-construction-productivity, page 1, and the February report In brief, page vi (supra)

[8] McKinsey Global Institute: *Reinventing construction through A productivity revolution*, February 2017, https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/ireinventing-construction-through-a-productivity-revolution, page 61

[9] McKinsey Global Institute: *Reinventing construction through A productivity revolution*, February 2017, https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/ireinventing-construction-through-a-productivity-revolution, In brief, page vi

[10] supra, page 2

[11] supra, page 2

1. Ensure fair contractual risk allocation between the various participants so that the *co-operation* essential for successful BIM is facilitated and nurtured [No.2 lever];
2. Champion the adoption of BIM as the disruptive process that the industry needs [No.6 lever].

However, the construction advisers need to be satisfied that the No.6 lever of BIM is part of the solution, and a brief review of the history of the UK and Australia's construction industry's response to poor productivity is needed.

D. Adoption of BIM to overcome low productivity

UK

The UK has had many inquiries into the industry including Latham[12], then Eagan[13], Eagan again in 2002[14], Wolstenholme[15], culminating in the 2011 *Government Construction Strategy.*[16] The 2011 paper stated, "*Government will require fully collaborative 3D BIM (with all project and asset information, documentation and data being electronic) as a minimum by 2016.*[17] This has taken place and therefore satisfies McKinsey's No. 6 lever.

As to the No.2 lever, the CIC BIM Protocol was developed to merely supplement existing construction contracts[18].

Australia

In Australia in 1990, '*No Dispute*"[19], recommended strategies for improvement in the Australian industry to avoid claims and disputes that had occurred in the 1980s caused by increasingly aggressive and confrontational relationships.[20] However, in 2014, the *Productivity Commission* stated essentially that, *inappropriately allocating risk* to those who cannot price or bear it, was counter-productive and promoted adversarial relationship, litigation and disputes[21].

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[12] Sir John Latham: *Constructing the Team, Joint Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry*, July 1994, HSMO London

[13] Sir John Eagan: *Rethinking Construction*, Report of the Construction Task Force (1998) to the Deputy Prime Minister, Department of Trade and Industry, London

[14] Sir John Eagan: *Accelerating Change*, a report for the Strategic Forum for Construction, London

[15] Andrew Wolstenholme: Never Waste a Good Crisis: A Review of Progress since *Rethinking Construction* and Thoughts for Our Future, Constructing Excellence in the Built Environment, (2009) Constructing Excellence, London

[16] Cabinet Office Government Construction Strategy May 2011

[17] Supra, 2 Strategy objectives, paragraph 2.32, page 14

[18] Mosey, David, Christopher Howard and Darya Barham: *Enabling Building Information Modelling through Procurement and Contracts*, A Research Report Kings College Centre of Construction Law and Dispute Resolution 2016, paragraph 4.1, pages 14-15

[19] Conference National Public Works, Building National and Council Construction, *No dispute: strategies for improvement in the Australian building and construction industry* (National Public Works Conference, 1990)

[20] Ibid Executive Summary page 1

[21] Australian Government, *Final report into Public Infrastructure* <http://www.pc.gov.au/projects/inquiry/infrastructure/report> page 485

Several industry papers and inquiries in Australia followed. In 2012, *buildingSmart* identified the need for Australian Government action to require BIM for procurement of its built environment projects by 1 July 2016, and the need for the development of Australian BIM contracts for adoption by 1 July 2014[22]. The proposal was to initially develop an addendum to be used in conjunction with current building and construction and design construction contracts. This strategy mirrors that of the UK, and therefore applies the No. 2 and No. 6 McKinsey's levers.

Neither of these milestones have been reached. However, four years later, *Smart ICT's* Recommendation 7 provides, *"…as part of its infrastructure procurement processes, require BIM to LOD500 on all major infrastructure projects, exceeding $50 million in cost, receiving Australian Government funding…with a view to ultimately establishing BIM as a procurement standard."*[23] No time appeared to have been set to achieve this goal.

From a national perspective, this appears to be the current status but in 2016, ACIF reported[24] on reasons for wasted effort. These align with those of *McKinsey*, and it said there was *no need for more inquiries or reports* but for *collaborative action* by governments, clients and service providers. It highlighted the importance of government as the policymaker and as a client, and that despite *industry doing the heavy lifting*, government needed to provide *leadership*. It developed 3 recommendations, the last two of which reflect the McKinsey's 2 levers:

1. Establish an independent Australian Centre for procurement excellent with a whole of government approach, but established independently of government;
2. *Fairer, standard contracts* using a leading practice approach consistent with public-sector framework of capital works procurement policies and practices, which *embody equitable risk allocations* whilst ensuring best value for end users and owners;
3. *Promote building information modelling* with government promoting the use of BIM on all Federal and State government building projects and all infrastructure projects.

Worldwide

This year the World Economic Forum (WEF) said, *"All types of IU[25] companies must prepare for the disruption created by the widespread use of 3D printing and other new technologies and business models. With the pace of change accelerating, they must act now to identify the right strategic moves to maintain their business and develop new business models that anticipate coming disruptions.*[26]

The WEF's BIM paper earlier said, "*To improve productivity, the IU industry must accelerate BIM adoption*[27]." This is the No.6 lever, and as to No. 2, it said, *"One option for doing that is*

[22] buildingSmart: *National Building Information Modelling Initiative Vol 1 Strategy*, 6 June 2012, Appendix C Stakeholder Consultation, Procurement, page 22

[23] Smart ICT: *Report on the inquiry into the role of smart ICT in the design and planning of infrastructure,* House of Representatives Standing Committee on Infrastructure, Transport and Cities, March 2016 Canberra ACT

[24] Australian Construction Industry Forum: *Boosting Construction Productivity Policy*, July 2016, page 3

[25] The Infrastructure and Urban Development Industry

[26] World Economic Forum (in collaboration with the Boston Consulting Group): *Shaping the Future of Construction: Future scenarios and Implications for the Industry* March 2018, Geneva, page 8

[27] World Economic Forum (in collaboration with the Boston Consulting Group): *Shaping the Future of Construction: An Action Plan to Accelerate Building Information Modeling (BIM) Adoption* February 2018, Introduction, Geneva, page 6

using integrated contracts to line up stakeholders' financial interests for all project activities and redefine risk-return mechanisms."[28]

The theme in Australia is therefore fairer standard contracts and BIM, which requires an understanding of what BIM involves.

E. BIM briefly explained

BIM has several meanings as it has rapidly developed in parallel with technology.

It has been described as a series of "*information models*" created and shared during key stages of a project. It is a digital prototype of an asset representing both its physical and functional characteristics which can be a shared resource of information once the building is in use.[29] It includes the concept of *Digital Engineering*[30]used by engineers.

Justice O'Farrell held, *"The BIM system is building information modelling. It comprises a software system which is intended to assist the design, preparation and integration of differing designs and different disciplines for the purposes of adequate and efficient planning and management of the design and construction process."*[31]

BIM is NOT Software, such as Autodesk, Revit, AutoCAD, Bentley AECOsim. They are *BIM Authoring Digital Tools* (Redstack[32]). Hurtado[33], Co-chair of the Working Group who drafted the BIM ConsensusDocs® 301 Addendum (2015), traced BIM's development in the US from *CAD on steroids* to a tool that can be used through the *lifecycle of a structure.* These software providers have created *CAD on steroids*, and have since facilitated BIM's development well beyond that, for which the industry must be grateful.

By reference to Fig 2 below, BIM means that when participant A in the construction project needs to access data from participant B's model; A's software can read B's data because it is available in the *Common Data Environment* (CDE)[34]. This is called a *Federated Model* because A can read B's data but cannot change it in any way. This follows an open data standard where each participant can use their own proprietary software to carry out their work.

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[28] Supra, Paragraph 2.2.1, page 9

[29] Redstack Pty Ltd 2017: *BIM Management Training Course*: BIM Fundamentals and Advanced Concepts, page 10

[30] https://www.engineersaustralia.org.au/portal/event/digital-engineering-bim-enhancing-construction-practises-realise-greater-efficiencies-delivery

[31] *Trant Engineering Limited v Mott MacDonald Ltd* [2017] EWHC 2061 (TCC)

[32] Redstack Pty Ltd 2017: BIM Management Training Course: BIM Fundamentals and Advanced Concepts, page 76 Training Day 2

[33] Hurtado, Kimberly A: *BIM comes of Age: The New ConsensusDocs BIM Addendum (2015) for Lifecycle Building information Modeling* (2016) The Construction Lawyer Vol 36, No.4 Fall 2016 by the American Bar Association, page 1

[34] PAS 1192-2:2013: *Specification for information management for the capital/delivery phase of construction projects using building information modelling* defining it as, *"single source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multi-disciplinary teams in a managed process,* page 3

It is useful to consider what BIM can do. NATSPEC[35] considers that BIM has various *uses* across a project, which should be in the BIM Brief. Hurtado explained the *uses* of BIM very neatly as a tool that can be used through the *lifecycle of a structure*. *Hurtado's tools* included:

1. Project conceptualisation;
2. Design development;
3. Construction;
4. Commissioning,
5. Operation;
6. Maintenance;
7. Possible decommissioning.[36]

The research revealed several aspects of BIM which are useful including:

1. It is possible to *visualise* the project in 3D (three dimensions) and ensure early clash detection, as well as a reduction in design errors and rework by the constructor. "D" in this context means "*dimension*"[37].
2. For example, 4D BIM includes the ability to schedule activities, and 5D can include cost information, which is not only of enormous benefit to the constructor, but also to the owner, *if they have access* to these dimensions of BIM, in predicting time and cost during the project;
3. 6D can support the operation of the finished asset, which is of interest to an owner. However, the WEF considers 6D as sustainability and 7D as operations and maintenance[38].

These additional *dimensions* of BIM are emerging rapidly, but as with a lot of BIM, it remains fragmented, and there are differing views on what each dimension encapsulates. A few other concepts need discussion to develop a fuller understanding of BIM, and *Level of Maturity and Level of Development* is important.

Level of maturity

Level 1, 2 etc refers to the level of maturity of BIM, graphically described in Fig 1 PAS 1192:2.2013[39].

The UK government recognised that its industry was not ready for full-scale BIM, so it mandated that in April 2016, Level 2 BIM was required for all public sector funded projects. The UK intends to move to Level 3, which is an *integrated data model* used by all participants. This approach was the result of several inquiries referred to under the heading *Productivity* above.

Level 2 means that each party can use their own software, but it must be capable of being exported to a *Federated BIM Model* where it can be shared in a common data environment (CDE), using common file formats e.g. *IFC* (Industry Foundation Class) and allows COBie (Construction Operations Building Information Exchange) to be provided for the owner's use.

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[35] Nat spec National BIM Guide, reconfirmed March 2016

[36] Supra

[37] https://www.thenbs.com/knowledge/bim-dimensions-3d-4d-5d-6d-bim-explained

[38] WEF BIM Adoption, page 5

[39] BSI Standards Limited 2013: PAS1192-2: 2013: *Specification for information management for the capital/delivery phase of construction projects using building information modelling.*
ISBN 978 0 580 82666 5

In Australia, although we have no nationally mandated BIM, it appears from the research that our industry could operate at Level 2 BIM. It is now important to revisit the concept of BIM *uses*, to demonstrate that not all projects follow all of Hurtado's tools or NATSPEC's *uses*.

Level of Development (LOD) essentially means the extent to which model elements have been developed, but a further LOD can provide more detail later[40]. Please see table 2 below.

BIM uses

Let us take 2 examples under a typical construct-only project, using the BIM ConsensusDocs® 301 BIM Addendum *Article 2* definitions to describe the process. Unfortunately, the Addendum does not graphically illustrate the process for example 2 below, so the extract of Fig 2 of PAS1192-2: 2013 was used to explain the information flow.

Example 1. It may be that extent of BIM on a project is confined to a designer's 3D model being provided to a constructor carrying out construction, without providing sufficient access to the digital data model to enable that the constructor and its subcontractors to import the data into shop drawings.

The designer may have shared its design model with the client, and this would be sensible for the client to have a benefit of the 3D model, but no additional benefit is achieved.

This fits within *Hurtado's tools 1 and 2* above but goes no further. This is more or less Level 1 BIM.

Example 2. Alternatively, a client may:

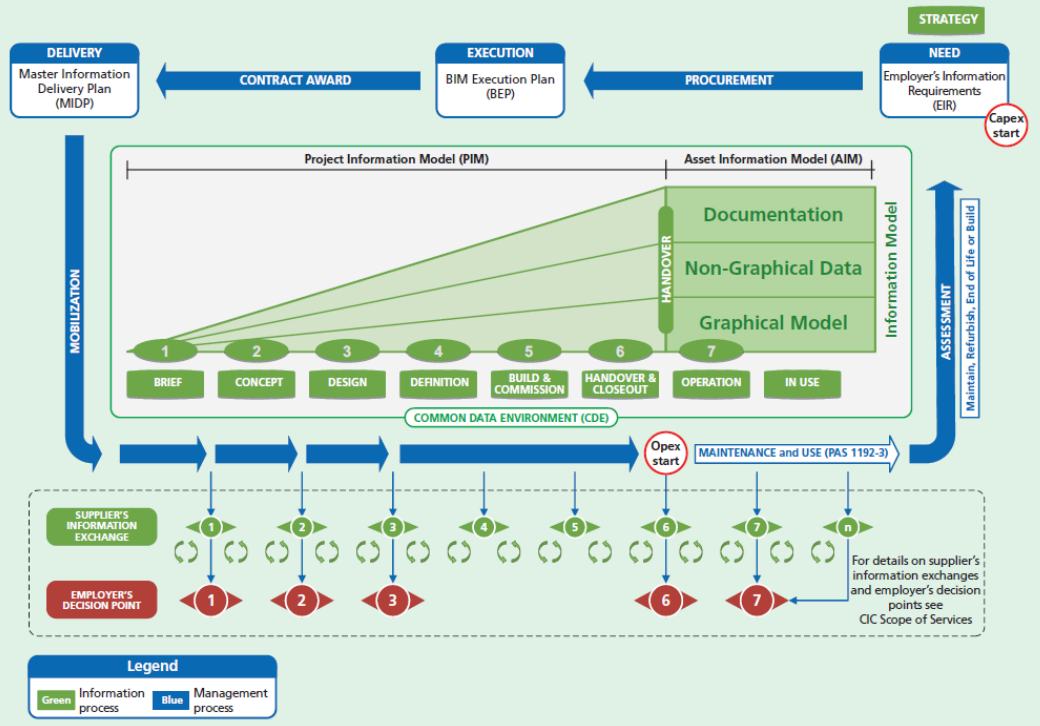
a. provide extensive information about its requirements ("EIR");
b. which is taken by the designer to develop a digital *Design Model*;
c. which is shared with the constructor in the Common Data Environment ("CDE");
d. enabling the constructor to read and use [but not alter] the data with its own software to:
    i. give to its suppliers and subcontractors to obtain data about the necessary equipment and shop drawings for the project in a *Shop Model*; and
    ii. populate its digital construction model for construction (the "*Construction Model/s*), which may include:
        1. scheduling data to sequence the activities;
        2. costing/estimating data; and
    iii. compare with the *Design Model* to resolve clashes (the "*Project Model*"); and
    iv. modify the *Construction Model* into the *Co-ordinated Construction Model*
    v. manage the construction activities; and
    vi. deliver an as-built digital model to the CDE (the "*As-Built Construction Model*";
e. which allows the client to read and use [but not alter] the data with its own software to manage the facility that has been constructed.

[40] NATSPEC NBP BIM & LOD

This fits within *Hurtado's tools 1 through to* 5, and NATSPEC'S section 7.1 to 7.7 and uses a *Federated Model* because, although each participant can link their models, data in each model cannot lose its identity or integrity when linked in the CDE. This is Level 2 BIM.

Both could be described as BIM projects, but the latter has far more data interfaces, and therefore risk to be allocated. Looking at Fig 2 to understand the process, which differs in terminology from ConsensusDocs® 301 Addendum, but follows the same methodology.

Figure 2 – The information delivery cycle



NOTE 1 The information delivery cycle as shown in Figure 2 has two distinct points of entry. For stand-alone new-build projects, start at the top right box "Need", but for projects that are part of a larger portfolio or estate, or for projects working on existing buildings and structures, then start at the right-hand arrow "Assessment" which draws on the information in the existing AIM. These points of entry are also referenced in the CDE – see 8.2. It is assumed that use will be made at both start points of portfolio information to inform decisions.

NOTE 2 The information delivery cycle shows in BLUE the generic process of identifying a project need (which may be for design services, for construction or for supply of goods), procuring and awarding a contract, mobilizing a supplier and generating production information and asset information relevant to the need. This cycle is followed for every aspect of a project, including the refinement of design information through the seven project stages shown in GREEN.

NOTE 3 The GREEN numbered ovals and annotated lozenges refer to the CIC Scope of Services stages. The GREEN image represents the CDE that will collect, manage, disseminate, exchange and retrieve information through the lifecycle.

NOTE 4 Information exchanges between project team members are indicated by small GREEN balloons.

NOTE 5 Information exchanges between the project team and the employer are indicated by larger red balloons to answer the Plain Language questions posed by the employer defined in the employer's information requirements (EIR) and referred to in Figure 7 (see 4.1.5).

Figure 2 PAS 1192-2:2013
Reprinted with kind permission from Mervyn Richards

PAS 1192-2:2013[41] Figure 2 shows the Information delivery cycle in BIM and illustrates the process and some of the definitions associated with BIM. The author gratefully acknowledges written permission from Mervyn Richards, the copyright holder of Figure 2 below. The reason for choosing PAS 1192-2:2013 is that NATSPEC and ConsensusDocs® 301 do not have diagrams to allow one to visualise the process.

The figure illustrates the BIM execution plan (BIM Management Plan in NATSPEC[42]), the project information model and the master information delivery plan, which are all described in the CIC BIM Protocol.

This gives an overview of BIM, and later some theoretical issues will be derived from the example 2 above, with assistance from Fig 2 to demonstrate the interplay between a BIM process and a contract.

It is to the standard contracts the paper now turns.

F. Standard contracts

In 2014, SOCLA supported a report[43] about the effectiveness of standard contracts in Australia, particularly regarding appropriately balanced risk allocation and facilitation of efficient contract administration. This research results dealt mainly with the Australian Standard contracts for Design and construction (D&C) AS4300 and AS4902 and Construct only AS4000 and AS2124.

In 84% of cases the standards were amended,[44] primarily to shift risk to another party[45].

The clauses that were amended included (in no less than 60% of occurrences) to EOT's (76%), delay damages (71%), site conditions (68%), payment (65%), variations (63%) and claims (62%).[46] All of these issues are well-known to construction advisers and the unamended standard were created to have a fair risk allocation.

If the Productivity Commission's 2014 *inappropriate risk allocation* conclusion, and McKinsey's mismatch in risk allocation and rewards[47] are still valid, then given the majority of the standard contracts are amended to shift risk, **one can conclude this shifting of risk in the standard contracts is inappropriate, otherwise we would have better productivity.**

This results in disputes and litigation, which is hardly fertile soil to plant BIM which must be watered with *collaboration*! The question must then be posed, whether Australia should adopt the protocol approach by attaching them to existing contracts.

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[41] PAS1192-2:2013 *Specification for information management for the capital/delivery phase of construction projects using building information modelling.* The British Standards Institute 2013
[42] Supra Section 3, page 3
[43] Sharkey, John Professor; Matthew Bell, Wayne Jocic and Rami Marginean: *Standard Forms of Contract in the Australian Construction Industry – Research Report* June 2014, The University of Melbourne.
[44] Supra, Section 9, page 35
[45] Supra, Section 10
[46] Supra Section 11, page 42
[47] Barbosa, Filipe; Jan Miske and Matthew Parsons: *Improving Construction Productivity*, July 2017 https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/improving-construction-productivity, page 1, and the February report In brief, page vi (supra)

G. Protocols in USA and the UK

USA
ConsensusDocs® 301 is a protocol first developed in 2008 by the AGM BIM Forum comprising representatives from all participants in the construction chain from designers, contracts and subcontractors through to owners. It also included the National Institute of Building Sciences, as well as construction lawyers.[48] It was revised in 2016 to include the expanding BIM activities well beyond design. does in the US, and the latter is used for appending to any Governing Contracts and all affiliated contracts of contributors. ConsensusDocs 301 does not create privity of contract,[49] but if there is a conflict, it takes precedence over the contract.[50] Its primary focus is the BIM process.

UK
The CIC in the UK developed the First Protocol in 2013 before BIM Level 2 was mandated by the UK Government for its projects in 2016. The second edition was published on 10 April 2018[51] and maintained the approach that existing construction contracts were largely to remain unaltered. It brought the Protocol more in line with PAS1192-2[52].

Consideration of particular provisions of the latter protocol has been done to illustrate the inability of the protocol to respond and facilitate collaboration in one example.

H. Some theoretical risk issues emerging from the BIM process

There are innumerable permutations that can apply across any project, so that one example is one of many possibilities. This one has been created, more to illustrate at a theoretical level the issues that might arise. The focus is on the Example 2 above and considers 2 possibilities arising out of the BIM process, and then applies the UK protocols to see if they facilitate collaboration. For brevity the US addendum was not used, and it did not create privity of contract[53] anyway.

An unamended AS4000-1997 is used, as it is likely to have the most equitable risk allocation.

Scenario 1
The Principal was rushed into bringing the project to market and had not fully considered and understood its information requirements (EIR). It advised the design engineer of an alteration to the EIR, which therefore meant the design changed, with consequential changes to the BIM execution plan (BEP see Fig 2, or the BIM Management Plan (BMP) using NATSPEC).

Arguably the design engineer could have foreseen the inadequacy of the EIR but had no incentive under its consultancy agreement to alert the Principal. Equally, the constructor, had

[48] Lowe, Richard H and Jason Muncey, *ConsensusDocs 301 BIM Addendum* Construction Lawyer, Vol 29, No 1, Winter 2009
[49] ConsensusDocs® 301: *Building Information Modelling (BIM) Addendum* Article 1.1
[50] Supra, Article 1.7
[51] Construction Industry Council: Building Information (BIM) Protocol 2nd edition 2018, *Building Information Council,* London
[52] Supra, paragraph 2, page v
[53] ConsensusDocs® 301: *Building Information Modelling (BIM) Addendum* Article 1.1

it been privy to the discussions surrounding the EIR at an early stage, could have entirely mitigated extra costs, for which it now claims a variation.

The revised design model is provided to the constructor who claims a variation under clause 36.1 (a) through to (d), to which it should be entitled under the contract unless a protocol amended this.

UK Protocol (2nd ed)
Clause 2 does not apply, as there is no ambiguity, conflict or inconsistency.
Clause 3.1.3(a) requires a review of the Information particulars [Appendix 2.1] at each stage, and both the designer's and constructor's rights should be assessed at that time. Presumably, the Superintendent could do so and issue the variation.

Clause 4 deals with the designer's and constructor's obligations to provide Specified information and publish it at the appropriate time. This does not apply to an EIR change.

There are no positive obligations on either to have collaborated earlier with the Principal about the EIR. The protocol therefore does not assist.

A sub-optimal result which could have been easily avoided with collaboration in this case under the contract, but it does not require it.

Scenario 2
The rushed project meant that the designer failed to deliver the required Level of Definition (UK)/Level of Development (NATSPEC) LOD300 at the agreed time in the BEP about some water pumps to allow ordering and final scheduling of the installation of the pumps. The earlier LOD200 delivered in time had showed the approximate geometry of the pumps.

By the time the LOD300 is provided, the constructor's digital model discovers that the pumps will need to be imported at higher cost and they will not be delivered on time.

It claims an EOT under clause 34 and variation under clause 36. The Superintendent argues that there is no change to the character and quality of the pumps and that no other subclause of 36.1 applies and rejects the variation.

Does the protocol assist?

UK Protocol (2nd ed)
Clause 2 could apply because there is an inconsistency in the Project Information and the parties could resolve the conflict regarding the variation. However, the protocol does not take precedence over the contract[54] and even if it did, how is the Superintendent involved - it is just the parties, unless the Superintendent is also the designer?
Clause 3.1.3(a) requires a review of the Information particulars [Appendix 2.1] at each stage, and the constructor's rights should be assessed at this time. Presumably, the Superintendent could do so and issue the variation.

Clause 4 deals with the designer's and constructor's obligations to provide Specified information and publish it at the appropriate time. The designer has breached this obligation,

[54] CIC Protocol 2nd ed, page v "**Protocol and Agreement**],

but there is no positive obligation on the constructor to have collaborated earlier and chased the designer for the LOD300.

Again, the protocol does not help and no collaboration was required under the contract. Another suboptimal result could have been avoided, if there was a positive obligation on the constructor to chase the designer for the LOD 300.

Naturally, this example may be extreme, so one cannot safely conclude on this basis alone that the standard contract protocol approach to BIM should not be adopted. However, it has been found that the standard contracts do not facilitate collaboration, and sometimes the protocol may not assist, so a search for an appropriate collaboration mechanism is made.

I. BIM's need for collaboration

Collaboration is the foundation of successful BIM[55]. If parties on a BIM project use a contract with inequitably allocated risk, to which a Protocol is added, to make it a "BIM project", it is suggested that the seeds of a potential disaster are sown.

The research has only found the case of Trant[56] for guidance about a BIM Project, and that was a decision about the suitability of an injunction to allow one party to have access to a partly completed design.

The WEF's BIM paper[57] said, "*Successful BIM adoption requires a high level of collaboration among stakeholders. Steps toward that include increased use of integrated contracts and open standards for data sharing."* These reflect McKinsey's No.2 and No. 6 levers.

Integrated contracts in this context means the owner enters into a *single agreement* for design, engineering, construction and possibly O&M services, making the success of each dependent on the other's contributions[58]. Examples given were design build (D&C) and integrated project delivery (IPD). This suggests a minimum of a D&C contract, such that the construct-only contracts would be inappropriate.

In Australia research suggests roughly 37% of contracts may be amended Australian Standards D&C contracts.[59] **This leaves over 60% of AS contracts that could not be classed as *integrated contracts* suggesting that they would not be suitable for BIM, if WEF is correct.**

This suggests that the contractual regime for BIM will need to be quite different from the standards currently in use, because without collaboration, it appears that BIM will be at best suboptimal, and at worst, a fertile ground for dispute.

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[55] Redstack supra, p 48
[56] *Trant Engineering Limited v Mott MacDonald Ltd* [2017] EWHC 2061 (TCC)
[57] World Economic Forum: *Shaping the Future of Construction: An Action Plan to Accelerate Building Information Modeling (BIM) Adoption* February 2018, Executive summary, in collaboration with the Boston Consulting Group, Geneva, Switzerland, page 4
[58] Supra, paragraph 2.2.1, page 9
[59] Sharkey, John Professor; Matthew Bell, Wayne Jocic and Rami Marginean: *Standard Forms of Contract in the Australian Construction Industry – Research Report* June 2014, The University of Melbourne, page5.

Collaborate in Australia devoted one chapter to Collaboration[60] (which included contracts) and focussed on risk sharing and a no blame culture and concluded that collaboration could be facilitated by:

1. Umbrella agreements, strategic partnerships and framework agreements; or
2. Alliance contracting[61].

Neither of these categories fall within the traditional AS contracts, and it is left to the construction advisers, until Government leads the way, to consider suitable approaches. This again suggest a deviation from the standard contract norm.

Stephenson and Molk[62] explained Alliance contracting, not in the context of BIM, and said that enforceability remained a concern, and that it had not yet been tested in an Australian Court. Their suggested alternative was an EPCM contract, where the owner had direct contracts with each trade contractor. It suffers from no incentive for the parties to cooperate to reduce costs and project completion time, so it is unsuitable.

Mosey et al[63] referred to the use of BIM models *enabling* collaborative working, but the context appeared to be confined to design consultants and their clients, and optimal BIM involves far more participants. However, they referred to Saxon's comment that, "*What partnering needed to succeed was BIM and this risk managing collaboration concept will probably return to favour in supply chain relationships*[64]."

Kannegieter of Engineers Australia says mistrust pervades the industry,[65] and this is a reality that cannot simply be wished away because BIM appears to be a better way.

It appears that inequitable risk allocation is an impediment to BIM adoption, because of the associated adversarial relationships that follow, and they exist in the current standard contractual regimes.

Suggestions for facilitating the collaboration needed include *integrated contracts* (D&C) and (IPD) with success dependent on other parties' contributions, which led on to the logical partnering and alliancing arrangements. These have not been considered in the paper, and are left as possibilities for further research.

J. Conclusion

1. BIM must be adopted as a new way of doing business, and construction advisers must take the lead in assisting their clients to get on board.

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[60] Collaborate: *BIM Legal and Procurement CWG 004 Utilising BIM is Australian and New Zealand Projects,* (2016), Chapter L4
[61] Supra Chapter L4, page 6
[62] Stephenson, Andrew and Brendan Molk 6 April 2016
https://www.corrs.com.au/assets/thinking/downloads/alliancing-in-australia.pdf
[63] Mosey, David, Christopher Howard and Darya Barham: *Enabling Building Information Modelling through Procurement and Contracts*, A Research Report Kings College Centre of Construction Law and Dispute Resolution 2016, paragraph 3.3, pages 12-14
[64] Supra, page 13, citing Richard G Saxon CBE (2013), "*Growth Through BIM*"
[65] Tim Kannegeiter, 'Confronting productivity in construction' (2014) 86(10) (October 2014) *Civil Engineers Australia* 6, p46

2. Collaboration is vital for successful BIM projects and the current standard contracts do not promote collaboration.
3. The protocol approach does not enhance collaboration by merely being appended to the standard contract.
4. A Fresh contractual regime is required to facilitate the essential collaboration.

	LOD 100 Conceptual	LOD 200 Approx. geometry	LOD 300 Precise geometry	LOD 400 Fabrication	LOD 500 As-built
Analysis	Analysis based on volume, area and orientation by application of **generalised** performance criteria assigned to **other** Model Elements.	Performance analysis of selected systems by application of **generalized** performance criteria assigned to the **representative** Model Elements.	Performance analysis of selected systems by application of **specific** performance criteria assigned to the **representative** Model Element.	Performance analysis of systems by application of **actual** performance criteria assigned to the Model Element.	Performance measured from installed systems.
Cost Estimating	Development of a cost estimate based on **current** area, volume or similar **conceptual** estimating techniques (e.g., square metres of floor area, hospital bed, etc.).	Development of cost estimates based on **approximate** data provided and **quantitative** estimating techniques (e.g., volume and quantity of elements or type of system selected).	Development of cost estimates suitable for procurement based on the **specific** data provided.	Costs are based on the **actual** cost of the Model Element at buyout.	Operation and maintenance costs measured from installed systems.
Project scheduling	Project phasing and determination of **overall** Project duration.	For showing ordered, time-scaled appearance of **major** elements and systems.	For showing ordered, time-scaled appearance of **detailed** elements and systems.	For showing ordered, time-scaled appearance of **detailed specific** elements and systems **including construction means and methods**.	Maintenance scheduling derived from installed systems.
Coordination	N/A	**General** coordination with other Model Elements in terms of its size, location and clearance to other Model Elements.	**Specific** coordination with other Model Elements in terms of its size, location and clearance to other Model Elements including **general** operation issues.	Coordination with other Model Elements in terms of its size, location and clearance to other Model Elements including **fabrication, installation** and **detailed** operation issues.	N/A
Other authorised uses	Additional Authorised Uses of the Model Element developed to **LOD 100**, if any, including Authorized Uses identified or required by the uses set forth in Section 4.4 of *AIA E203-2012*.	Additional Authorised Uses of the Model Element developed to **LOD 200**, if any, including Authorized Uses identified or required by the uses set forth in Section 4.4 of *AIA E203-2012*.	Additional Authorised Uses of the Model Element developed to **LOD 300**, if any, including Authorized Uses identified or required by the uses set forth in Section 4.4 of *AIA E203-2012*.	Additional Authorised Uses of the Model Element developed to **LOD 400**, if any, including Authorized Uses identified or required by the uses set forth in Section 4.4 of *AIA E203-2012*.	Specific Authorised Uses of the Model Element developed to **LOD 500**, if any, including Authorized Uses identified or required by the uses set forth in Section 4.4 of *AIA E203-2012*.

Table 2: LOD – Authorized Uses

NATSPEC'S LOD TABLE, page 10 NBP 001 Nov 2013
BIM and LOD