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Public Infrastructure Inquiry
Productivity Commission
LB2 Collins Street East
Melbourne VIC 8003
Australia

20 December 2013

Dear Sir/Madam,

We are extremely grateful for the opportunity to respond via a public submission to the Productivity Commission's Public Infrastructure Inquiry. Recognising the Inquiry seeks to address a range of issues, our submission focuses on addressing the following key issues as laid out in the Inquiry's terms of reference:

- Provide advice on ways to improve decision-making and implementation processes to facilitate a reduction in the cost of public infrastructure projects, including in relation to: measures to improve flexibility and reduce complexity, costs and time for all parties.
- Comment on other relevant policy measures, including any non-legislative approaches, which would help ensure effective delivery of infrastructure services over both the short and long term.

What is Building Information Modeling (BIM)
Building Information Modeling (BIM) is a process involving the generation and management of digital representations of physical and functional characteristics of a facility or infrastructure. BIM processes are typically used by individuals, businesses and government agencies that plan, design, construct, operate and maintain diverse types of infrastructure.

For professionals involved in an infrastructure project, BIM enables a virtual information model to be handed from the design team (architects, surveyors, civil and structural engineers) to the main contractor and subcontractors and then on to the owner/operator; each team adds discipline-specific data to the single shared model. This reduces information losses that traditionally occur when a new team takes 'ownership' of the project, and provides more extensive and rich lifecycle information to owners of complex structures.

Role of BIM in Developing Public Infrastructure
With BIM, the entire process of developing and executing public infrastructure projects can be streamlined, from initial surveying and data collection through to environmental review, public participation, design, contracting, construction and operations and management. Three dimensional models can also be used to assess the sustainability of a project by incorporating social, political, cultural, and economic information.

Better collaboration on designs by all project stakeholders – designers, contractors and owners – during all the phases can reduce up to 20 percent or more of project costs associated with rework. By doing so, the requests for information (RFI's), associated change orders and general errors and omissions are reduced through early detection and better understanding of conflicts and ability to resolve them before construction. There are many causes of rework – and none are intentional – but one major contributing

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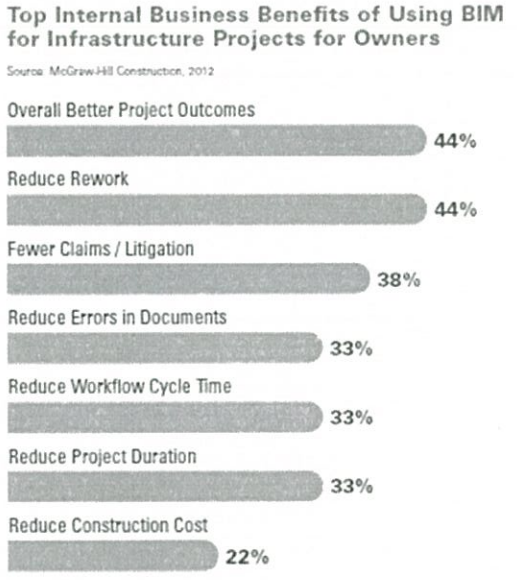
factor is digging through and processing hundreds, if not thousands of sheets of paper or 2D CAD files with millions of bits of information looking for conflicts or missing information, even transposed numbers. The task is daunting and most of the time nearly impossible to make error proof, no matter how many QA cycles, tight timelines, or strict budgets.

This is where Building Information Modeling (BIM) comes into its own. Designing with intelligent 3D models, and using a BIM workflow to facilitate 4D (time) and 5D (cost) discussions simultaneously on the design, are critical components to changing the rework dynamic. On the horizon now is also 6D (sustainability/triple bottom line analysis) which will become increasingly more important to infrastructure design and delivery approaches in the future.

A large proportion of Public Private Partnerships (PPPs) implemented today include BIM as a requirement because of its enabling capability for design and construction, and for the benefits it provides owners and stakeholders, as explained in a McGraw-Hill Smart Market BIM for Infrastructure Report. Key findings in the report include:

- **67% of current users of BIM for infrastructure report a positive ROI on their BIM investments**. Greater experience contributes to higher ROI—over 40% of the users who identify themselves as experts in BIM use for infrastructure report an ROI of 50% or greater.
- Most current users already enjoy reduced conflicts and changes, and improved project quality, **and believe that the emerging benefits of lower project risk and greater predictability of project outcomes** will motivate them to increase their use of BIM in the future.



The Business Value of BIM for Infrastructure 2012 Smart Market Report. Source: McGraw-Hill Construction

Simply put, a BIM helps engineers, planners, owners and investors gain valuable insight across the lifecycle of a project from early planning through to construction and operations. Because everyone involved in a BIM project works from the same 3D model, they share the same reliable, coordinated and consistent information to support more informed decision making.

A BIM process moves key decisions from the field to the computer screen where they are relatively easy and cost-effective to resolve. The entire process of developing and executing infrastructure projects can be transformed, from initial surveying and data collection through environmental review, public participation, design, contracting, construction and the operations and management of the asset. By using BIM's 3D design and modeling tools, planners, engineers and contractors can explore innovative designs and "multiple what-if" scenarios with project investors to test alternatives, simulate real-world performance to better understand cost and scheduling, assess the environmental impact of a project, and provide the public with accurate visualizations of the completed project throughout the process. The 3D models can also be used to provide the public with more accurate visualizations of the completed project. Modeling in 3D also enables the use of automated GPS machine guidance

technologies during construction that link the model with heavy equipment to improve precision and accuracy, and greatly reduce construction time and fuel, material waste while increasing the safety of people.

Role of BIM in PPPs

The necessary public sector mindset and skills base for successful PPP programs and projects differ substantially from those needed for conventional practices. Project outputs are what customers focus on: reliable travel times, safe travel environment, comfortable ride, etc. Thinking first about what customers desire as the end result rather than developing a prescriptive definition of the asset is a major transition in practice for infrastructure development, but one whereby modeling simulation and analysis can readily deliver enhanced outcomes.

The US Department of Transportation (US DOT)/Federal Highways Administration developed a global infrastructure study (http://international.fhwa.dot.gov/pubs/pl09010/) that researched and compared characteristics that make up successful PPPs to develop a set of best practices. When we compare these best practice characteristics with the benefits of what a BIM process has delivered within the infrastructure & building industries, it is clear BIM can greatly enhance and support these PPP best practices:

Best Practice PPP Characteristics	How BIM supports PPP Best Practices
Importance of adequate front-end or preliminary planning for a project to fully comprehend its business case and potential life-cycle value.	• Explore design ideas • Visualize projects • Analyze & test to simulate real-world application and performance • Incorporate an intelligent model–based process that can help take projects from concept to completion, faster, more economically, and with less environmental impact
Highway PPP arrangements, particularly in mature markets, are not exclusively financial transactions; rather, they are the selected project delivery strategy based on a value-for-money or feasibility analysis.	• BIM enables rapid Design – Visualize – Simulate • Collaborate across the extended project team • Deliver visualization capabilities that enhance the planning and design process, help architecture, engineering, and construction (AEC) firms and infrastructure owners win stakeholder approval for new projects
When defining or scoping a PPP project, the primary focus should be on identifying and conveying the outputs desired without inappropriately compromising existing technical standards.	▪ Enable smarter and more sustainable decision making ▪ Improve the ability to collaborate across functional groups, bringing consistency to the plan, design, build, and management lifecycle ▪ Enable outcome based design approach not just a prescriptive based one
Risk analysis and allocation are paramount to PPP project success.	▪ Increase project efficiency and performance ▪ Develop & deliver more coordinated & consistent information ▪ Reduce project risk, liability and contingency fees ▪ Address clashes, collisions and design challenges

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Best Practice PPP Characteristics	How BIM supports PPP Best Practices
	during design not construction reducing risk and liability
PPP arrangements can allow the delivery of projects sooner than would be possible through their other delivery methods	▪ Optimize a design's performance before it's ever built ▪ Enhance the collaborative process by which a built environment is created and maintained ▪ Deliver the most innovative design alternatives by boosting creativity and improving production efficiency
Public agencies emphasized the need for transparency during the procurement process for PPP projects. The typical scale and complexity of PPP projects generate an unusually high level of public, political, and media attention.	▪ Increased accountability & transparency with stakeholders ▪ Enable rapid Design – Visualize – Simulate ▪ Deliver visualization capabilities that enhance the planning and design process, help architecture, engineering, and construction (AEC) firms and infrastructure owners win stakeholder approval for new projects
Public agencies claimed that PPP projects provide better price and time certainty on design and construction when compared to the conventional approach and generally lead to design and construction efficiencies, which result in better pricing and scheduling by the private sector	▪ Analyze and simulate complex design options early ▪ Improve accuracy of designs and construction efficiency.
Public agencies in many countries continue to face challenges when it comes to providing serviceable highways and roadways. **Not a single public agency indicated that it had a surplus of funds available for expansion, restoration, and preservation** of its highway assets	▪ Reduce the cost of borrowing by increasing predictability in the supply chain and reducing risk to the financial institution ▪ Provide an opportunity to develop and evaluate more cost effective design alternatives with 3D model–based design, analysis, and simulation capabilities
Innovation in PPP arrangements is evident. In the case of the private sector, innovation is typically stimulated by competition for the award of an integrated, commercial enterprise. In the case of the public sector, innovation is typically driven by stewardship of public interests.	▪ Intelligent information supporting the entire project lifecycle ▪ Collaborate & share digital information with project stakeholders ▪ Virtually explore project constructability
PPP contractors exhibit a focus on their customers, an emphasis on life-cycle management and value, and a pride in ownership and stewardship of their assets	▪ Cost-effective design & analysis to help meet short term and long term sustainability and infrastructure resiliency goals/objectives
All countries **use key performance indicators (KPIs) or performance measures** in their PPP contracts to assess service along with incentives and disincentives to motivate contractor performance	• Improve safety (reduce lost time incidents) and environmental performance with project modeling/virtual construction to improve on-field coordination between people and equipment

Best Practice PPP Characteristics	How BIM supports PPP Best Practices
PPP project development time was remarkably efficient. In some countries, the entire procurement process, from **circulation of an environmental document to attainment of financial close, averaged 12 months**	▪ Collaborate & share digital information with project stakeholders ▪ Provide an opportunity to develop and evaluate more cost effective preliminary design alternatives with 3D model–based design, analysis, and simulation capabilities
PPP projects provide better price and time certainty on design and construction when compared to the conventional approach. The scale and complexity of and competition for PPP contracts generally lead to design and construction efficiencies, which result in better pricing and scheduling by the private sector	▪ Analyze and simulate complex design options early ▪ Improve accuracy of designs and construction efficiency ▪ Help mitigate increased costs associated with risk due to unforeseen issues such as clashes or collisions
The two most commonly cited attributes of a project that potentially make it a PPP candidate were scale and complexity. The scale attribute is necessary to offset the transaction costs of PPP's, while complexity is generally seen as the ingredient that enables or perhaps compels the private sector to find novel or unique project solutions.	▪ Improve cost and time reliability through more accurate information and model detailing of all complex project components

International Context of BIM in Developing Public Infrastructure

BIM standards and processes are being applied to a wide range of public infrastructure projects throughout the world:

- UK BIM Mandate: *"The UK is now recognised by its peers as one of the leading nations in the exploitation of BIM technology and processes with an internationally respected centrally-led programme3. BIM is a key agent for economic growth in both domestic and international markets"*
- Singapore BIM Mandate: *"In Singapore, the Building and Construction Authority (BCA) implemented the BIM Roadmap in 2010 with the aim that 80% of the construction industry will use BIM by 2015. This is part of the government's plan to improve the construction industry's productivity by up to 25% over the next decade"*
- NATSPEC - Standardised Australian Practice for Exchange of Digital Building Information: *"NATSPEC believes that digital information, including 3-D Modelling and Building Information Modelling, will provide improved methods of design, construction and communication for the industry"*
- US Department of Transport Federal Highways Administration: *"Three-dimensional (3D) modeling in transportation construction is a mature technology that serves as the building block for the modern-day digital jobsite. The technology allows for faster, more accurate and more efficient planning and construction. As the benefits are more widely recognized, many in the U.S. highway industry will transition to 3D modeling over the traditional two-dimensional (2D) design process."*
- New York City Department of Design & Construction: *"Managing the design and construction for New York City's capital projects is an increasingly collaborative process. Because of this, DDC continually looks for ways to improve the collaborative process. One way to do so is by using*

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Building Information Modeling. BIM strengthens collaboration by allowing all members of the design team to accurately add to a shared database information about how a building looks and functions."

BIM Case Study: Ipswich Motorway: Dinmore to Goodna, Queensland, Australia

Eight kilometers of the Ipswich Motorway from Dinmore to Goodna (D2G) in South East Queensland, Australia, was upgraded to increase safety for users, improve transportation efficiency, and reduce congestion, with a budget allocated of AUD1.95 billion. In May 2012, the upgraded and widened motorway was fully opened to traffic, six months ahead of schedule and ten percent under budget. Using BIM processes to link 2D geographic information systems (GIS) and 3D design and construction data enabled teams working on the project faster access to current information and faster, better communication of that information. This integrated environment provided significant cost, time, and quality savings. A more detailed explanation of this case study and the value derived from the use of BIM processes is attached to this submission.

Further Information

We at Autodesk are firmly convinced of the value BIM can generate for the development of public infrastructure as envisaged within the scope of the Productivity Commission's Inquiry. BIM's value plays out in contributing to improved decision-making outcomes, reduced complexity, costs and time lost over the lifecycle of a public infrastructure project, and also higher-quality public policy outcomes and greater stakeholder buy in. We remain at the Commission's disposal to provide further information, including follow-up meetings or presentations, as required.

Yours sincerely

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