2019 MACRO BIM ADOPTION STUDY IN PERU

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Cover image: Aerial view of National Sports Village built for the Pan American and Parapan American Games Lima 2019. Copyright © 2019 COSAPI S.A.

You may cite this document as:
Murguia, D. (2019). Macro BIM Adoption Study in Peru. School of Engineering, Pontifical Catholic University of Peru, Lima.

Produced in Peru,
School of Engineering 2019
Pontifical Catholic University of Peru
University Rd. 1801, San Miguel, Lima

INTRODUCTION

The "First Macro BIM Adoption Study in Peru" is the result of a collaboration between the BIMe Initiative and the School of Engineering of the Pontifical Catholic University of Peru.

The findings of this report are intended to assist policymakers in defining policies, strategies, and plans for the diffusion of BIM at a market scale.

From the BIMe Initiative, the project is led by Dr Bilal Succar of Change Agents, Australia, and Dr Mohamad Kassem of Northumbria University, United Kingdom. From the Pontifical Catholic University of Peru, the project is led by Danny Murguía.

More information about the BIMe Initiative Macro Adoption Project can be found at https://bimexcellence.org/projects/macro-adoption/

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CONTENT

EXECUTIVE SUMMARY

In the Peruvian context, **Building Information Modelling (BIM)** is a collaborative methodology based on the use of digital models, with the aim of centralising project information throughout the asset life cycle (Ministry of Economy and Finance 2019). BIM has been used in the Peruvian industry since 2010. The First BIM Adoption Study in Lima and Callao found that 24.5% of building projects implement BIM (Murguia et al. 2017).

This report presents the results of the **First Macro BIM Adoption Study in Peru** developed between January and May 2019. It reports on the 5 Macro Adoption models developed by Succar and Kassem (2015). A two-stage Delphi Method has been used, with 22 experts from industry and academy. The main findings of this report are:

- **Model A– Diffusion Areas:** The industry capability in the modelling stage is medium; in the collaboration stage is medium-low; and in the integration stage is low.
- **Model B – Macro Maturity Components:** The eight maturity components were rated by experts as:
  - Medium Maturity: technology infrastructure; champions and drivers.
  - Medium Low Maturity: noteworthy publications; learning and education.
  - Low Maturity: objectives, stages and milestones; regulatory framework; metrics and benchmarks; standardised parts and deliverables.
- **Model C – Diffusion Dynamics:** The diffusion dynamic in Peru was middle-out. BIM use has started with general contractors.
- **Model D – Policy Actions:** At the close of this report (May 2019), the policymakers exhibit passive communication (make aware); passive engagement (encourage); and passive monitoring (observe).
- **Model E – Diffusion Responsibilities:** The level of involvement of stakeholder groups in facilitating and encouraging BIM were rated by the experts as:
  - Medium High: Construction organisations (contractors)
  - Medium: Educational Institutions; Technology service providers, Industry Associations, Technology Developers, Communities of practice (Peruvian BIM Committee)
  - Medium Low: Policymakers

The results of this report are timely in light of the publication of the "National Competitiveness and Productivity Plan" led by the Ministry of Economy and Finance, which includes BIM as a strategic pillar.

METHODOLOGY

This study has been based on the 5 models shown in Figure 1 and described in Succar and Kassem (2015). The research tool is a standardised survey developed by the BIMe Initiative. This survey has been applied in more than 20 countries. It was decided to use a two-stage Delphi Method to seek consensus among a panel of experts. The project had four stages:

- **Stage 1 - Data Collection Round 1:** The researcher sent invitations to participate to 35 BIM experts (BIM consultants, academics, software providers, clients, BIM champions, representatives of construction companies, among others). 26 experts agreed to be part of this study. A link to the survey was sent to each participant, and up to 3 reminders were sent every 2 weeks. As a result, 22 valid responses were obtained.

- **Stage 2 – Data Analysis:** The data was analysed. There was a lack of consensus in Models C and E.

- **Stage 3 – Data Collection and Analysis Round 2:** Round 2 surveys were sent to participants. 18 valid responses were received and consensus was achieved in Models C and E.

- **Stage 4 – Publication of Results:** The study's findings were compiled in a report in English and Spanish. The dataset is open access and can be downloaded at this link (https://bimexcellence.org/projects/macro-adoption/completed-adoption-studies/macro-bim-adoption-in-peru/).

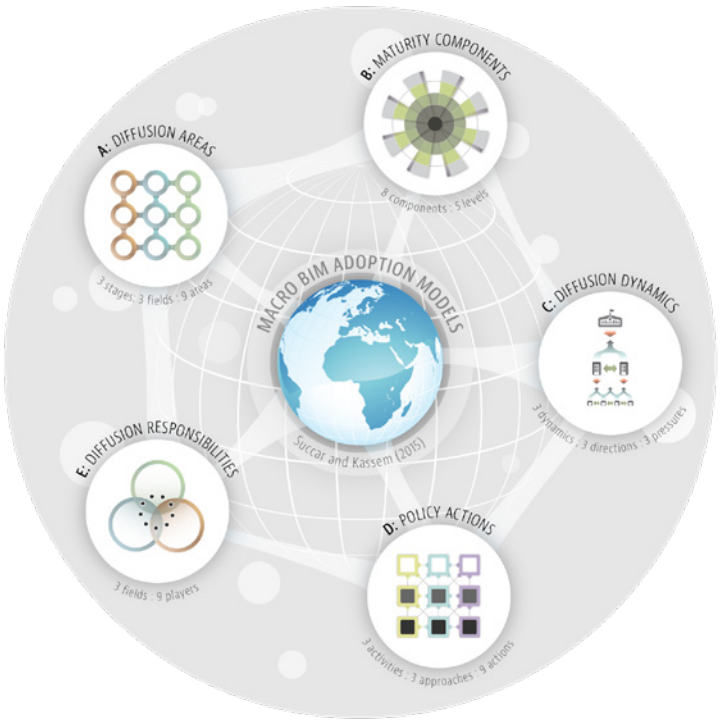


Figure 1: Macro Adoption Models. Source: BIMe Initiative

MODEL A - DIFFUSION AREAS

Model A establishes the interaction between the BIM fields (technology, processes and policies) with BIM capability stages (modelling, collaboration, and integration). As a result, 9 diffusion areas are generated (Figure 2).

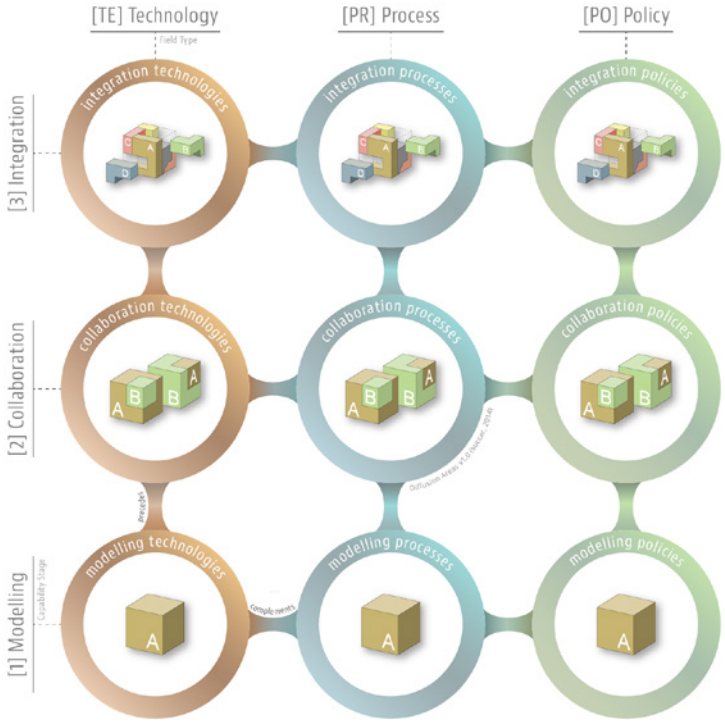
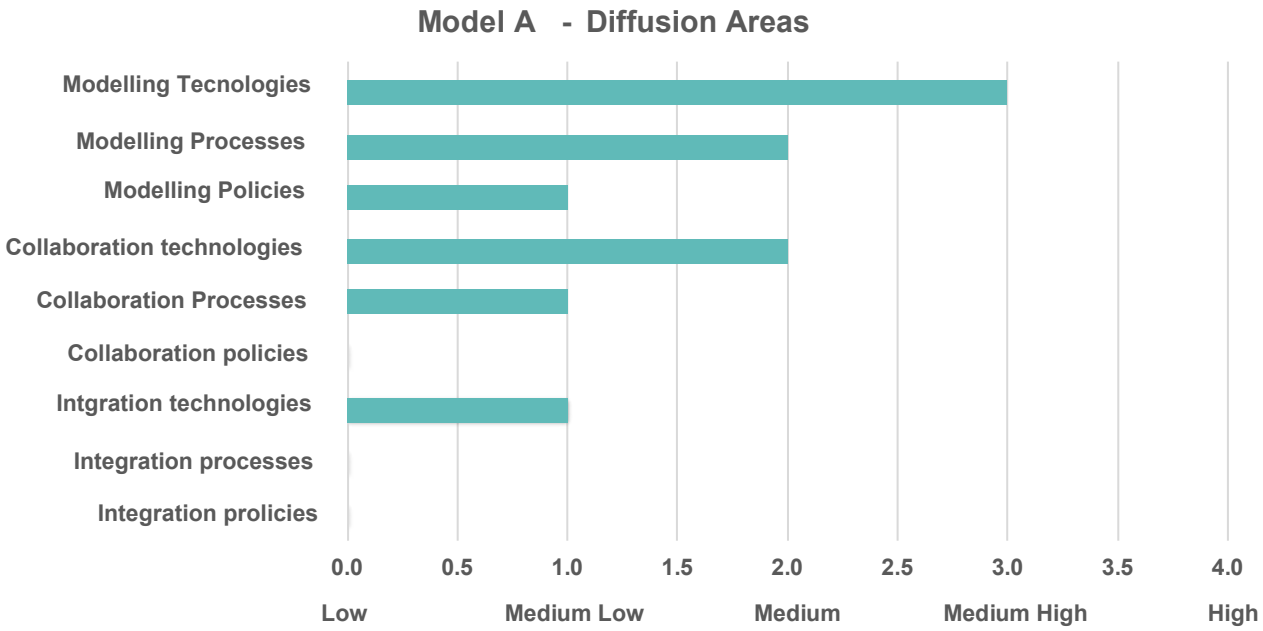


Figure 2: Model A - Diffusion Areas. Source: Succar and Kassem 2015

Each diffusion area (modelling technologies, modelling processes, modelling policies, collaboration technologies, collaboration policies, integration technology, integration processes, and integration policies) was measured in a scale from 0 to 4, where 0 = Low; 1 = Medium Low; 2 = Medium; 3 = Medium High; 4 = High. Table 1 and Figure 3 present the consensus reached by the panel of experts.

Table 1: Diffusion Areas. Results

	Field Technology	Field Processes	Field Policies
Stage 1 BIM: Modelling	Medium High (3)	Medium (2)	Medium Low (1)
Stage 2 BIM: Collaboration	Medium (2)	Medium Low (1)	Low (0)
Stage 3: BIM Integration	Medium Low (1)	Low (0)	Low (0)



FFigure 3: Model A - Diffusion Areas. Results

- **Modelling:** Modelling technologies and processes have a higher maturity compared to other diffusion areas. This could be explained by the fact that "early adopters" have nearly 10 years of BIM experience. However, 2D and 3D information co-exist in most projects as clients still deliver 2D drawings whilst contractors create 3D models for visualization, 3D coordination, and clash detection. Therefore, the adoption of modelling policies (standards) to create information is "Medium Low". There is a lack of national modelling standards. Some companies have created their own standards with in-house staff or outsourced consultants.

- **Collaboration:** Collaboration technologies for interdisciplinary collaboration have been used in the last 5 years. Some contractors have BIM teams with "BIM Managers" or "BIM Coordinators". However, most designers (architects and engineers) do not hold these positions in their companies. Due to the co-existence of 2D and 3D information, there is a lack of collaboration protocols to create native 3D information. Collaborative contracts have been used in the "Pan American Games Project", however, its use in the industry is in a nascent stage.

- **Integration** The integration stage has the lowest results. The use of common data environments or model servers is very limited. To improve this performance, the collaboration stage should be enhanced first.

MODEL B - MACRO MATURITY COMPONENTS

Model B identifies eight complementary macro maturity components to measure and establish the BIM maturity of countries. These are Objectives, Stages and Milestones; Champions and Drivers; Regulatory Framework; Noteworthy Publications; Learning and Education; Measurements and Benchmarks; Standardised Parts and Deliverables; and Technology Infrastructure, as shown in Figure 4.

Figure 4: Model B – Macro Maturity Components. Source: Succar and Kassem 20152015

The participants were given a description of the metrics used for the assessment of each component (Succar and Kassem 2015). Based on the descriptor, participants rated each component on a maturity scale from 0 to 4, where 0 = Low; 1 = Medium Low; 2 = Medium; 3 = Medium High; 4 = High. The panel of experts reached the consensus shown in Table 2.

The results reveal that none of the components of Macro Maturity Components have a rating of 3 or 4 (Medium High or High respectively), which is consistent with the observations made by the panel.

Table 2: Macro Maturity Components. Results

Component	Consensus	Maturity
Objetives, stages and milestones	0	Low
Champions and Drivers	2	Medium
Regulatory Framework	0	Low
Noteworthy Publications	1	Medium Low
Learning and Education	1	Medium Low
Metrics and Benchmarks	0	Low
Standardised Parts and Deliverables	0	Low
Technology Infrastructure	2	Medium

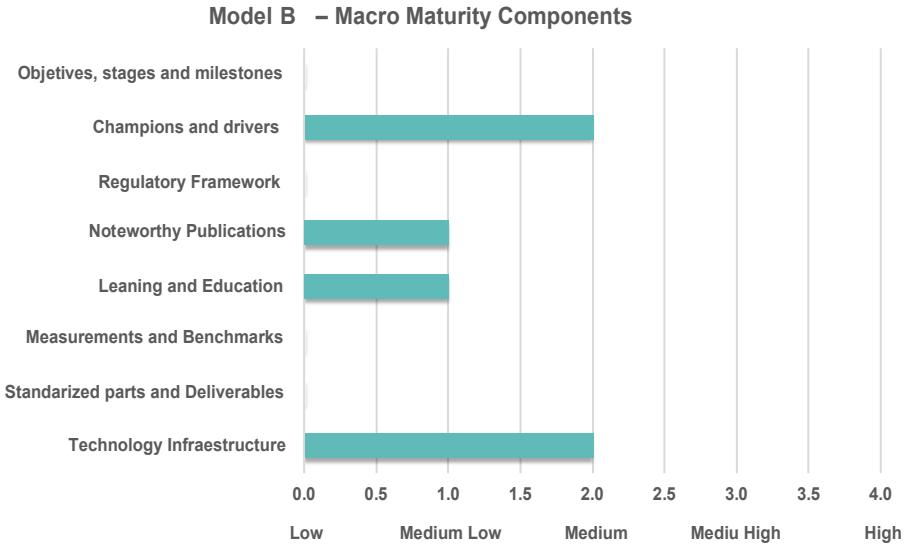


Figure 6: Macro Maturity Components. Results

"**Technology Infrastructure**" and "**Champions and Drivers**" are the components that have been assessed as "Medium" maturity. Indeed, the use of software for 3D modelling and collaboration is available in the market. This result is consistent with findings in Model A. "**Champions and Drivers**" have been identified as the BIM leaders of the construction firms and members of the Peruvian BIM Committee that have organised 4 International BIM Conferences and have made efforts to influence public and private decision makers.

"**Noteworthy Publications**" and "**Learning and Education**" have been assessed as "Medium Low" maturity. Indeed, there is a lack of guides, protocols, and mandates. However, the National Competitiveness and Productivity Plan have proposed the following:

- BIM Standards and Requirements (July 2021)
- Pilot projects using BIM (July 2021)
- Use of BIM in public projects in selected typologies (July 2025)
- Regulatory Framework to articulate BIM with public administrative systems (July 2025)
- BIM mandate for the entire public sector (July 2030)

The only report available on BIM adoption in Peru can be found in the First BIM Adoption Study in Lima and Callao (Murguia et al. 2017) who found that 24.5% of the building projects use BIM. The most typical BIM uses are visualisation, collaborative design, and clash detection.

BIM education has started in universities. The Pontifical Catholic University of Peru has a BIM optional module in the Civil Engineering course since 2014 and numerous thesis on this subject (http://tesis.pucp.edu.pe/repositorio/handle/20.500.12404/11/). The National University of Engineering has a Laboratory of Virtual Design and Construction in the School Civil Engineering with the aim to do research on BIM use in buildings and infrastructure projects (http://www.labdcv.uni.edu.pe/investigacion/). The new Civil Engineering course of the University of Lima has incorporated BIM into the core modules (http://www.ulima.edu.pe/pregrado/ingenieria-civil/cultura-bim-vdc). However, there is a lack of evidence of efforts to incorporate BIM in tertiary curricula of architecture and other engineering programmes as well as technical courses. Therefore, there is a gap between the current state of BIM education and the challenges to be posed in the near future.

The components **"Objectives, Stages and Milestones"**, **"Regulatory Framework", "Metrics and References", and "Standardised Parts and Deliverables"** have been rated as "Low" maturity. This finding matches the observed reality. With the leadership of government, industry and universities, these components will have greater maturity in the following 5 years, especially with the development of the "National Competitiveness and Productivity Plan" led by the Ministry of Economy and Finance. As part of the plan, a BIM roadmap will be presented in March 2020, and a Regulatory Framework will be launched in July 2025.

Subcontractors and suppliers can create 3D objects of standardised elements (pipes, doors, windows, electrical and mechanical systems, curtain walls, furniture, etc.) to be widely used by the public or private sector. A National BIM Plan should consider the creation of a body responsible for creating and curating the national library of BIM objects, or use international databases such as the NBS Library (https://www.nationalbimlibrary.com/en-gb/).

MODEL C - MACRO-DIFFUSION DYNAMICS

This model explains how BIM has started in each country and how it spreads in the population of adopters. The three dynamics are explained in Table 3 and Figure 7.

Table 3: Macro-Diffusion Dynamics. Source: Succar and Kassem 2015

Mechanism	Institutional actor	Pressures	Potential adopter
Top-down	Government or regulatory body	Downwards	All actors under the influence of the authority exerting pressure
		Horizontal	Governments and authorities in other markets
Middle-out	Large organisation or industry association	Down	Other companies in the supply chain
		Upwards	Government or regulatory bodies in the same market
		Horizontal	Other large companies
Bottom-up	Small firm	Upwards	Large companies or industry associations
		Horizontal	Other small firms

77% of the panel of experts responded that the diffusion dynamic in Peru was middle-out, while 18% argued it was bottom-up, and only 5% stated it was top-down. The middle-out approach is very close the lower threshold for consensus (80%). Therefore, the diffusion dynamic in Peru was middle-out, starting with large contractors.

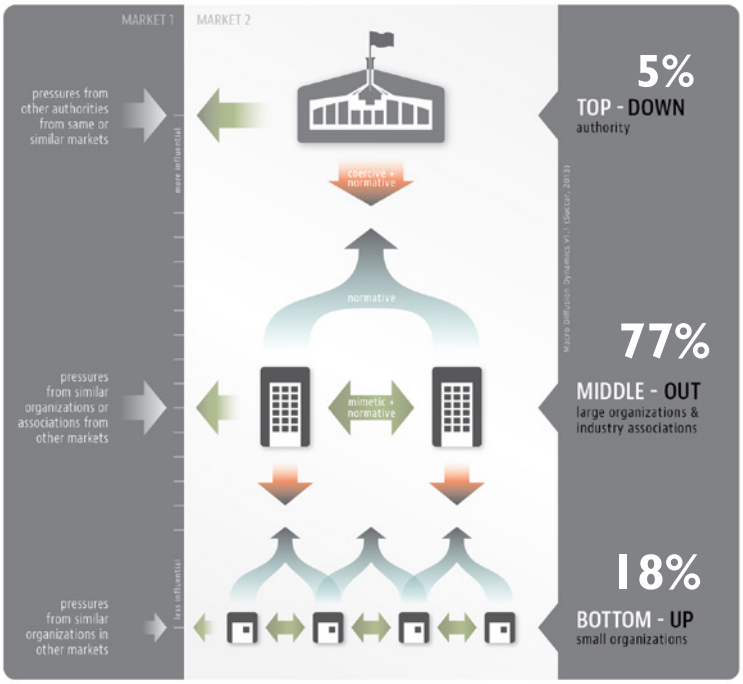


Figure 7: Model C - Results

Large contractors started using BIM to improve the quality of 2D information delivered by the client and to deliver value engineering. In addition, some large companies exerted pressures to subcontractors and suppliers to use 3D modelling in the design phase. This is the dominant dynamic. A few clients, developers and public agencies started using BIM proactively, but only as isolated cases.

The horizontal, upward and downward pressures can be summarised as follows:

- **Horizontal:** other construction companies have started using BIM
- **Downwards:** other small and medium enterprises (designers and subcontractors) have started using BIM with the influence of the general contractor.
- **Upwards:** private clients, developers, and project management firms have started using BIM due to contractor's pressure. The government has also initiated a BIM strategy. However, this is not the dominant mechanism.

MODEL D - POLICY ACTIONS

This model focuses on the actions of policymakers to influence the adoption of BIM at the industry level. The model focuses on three types of activities (communicate, engage, monitor) with three implementation approaches (passive, active, assertive). Each of these approaches means an increase in the involvement of policymakers to facilitate the use of BIM. As a result, 9 policy actions are generated.

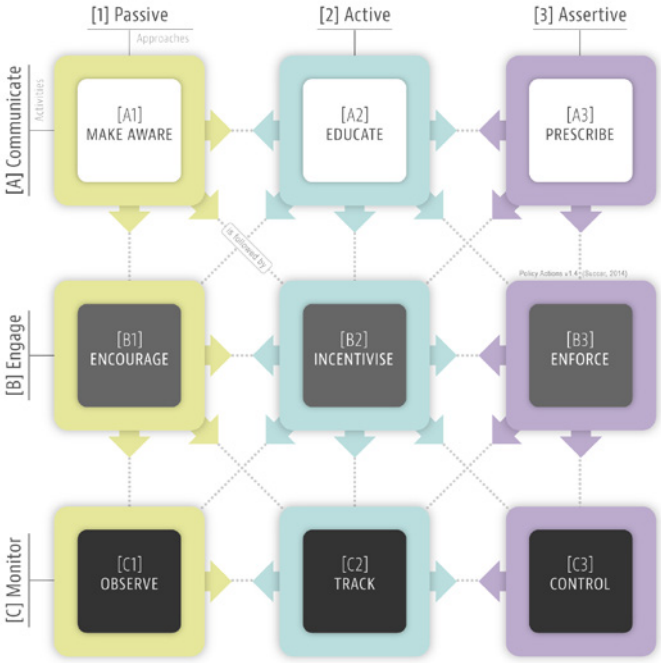


Figure 8: Model D – Policy Actions. Source: Succar and Kassem 2015

The panel of experts were asked to select three actions that best represent the approach taken by their respective policymakers. Figure 9 shows the results of Model D. Policymakers in Peru exhibit predominantly a **passive** approach in **communication**, **engagement** and **monitoring** (67%, 76% and 77% respectively). In addition, experts responded that policymakers have active communication (29%), active engagement (24%), and active monitoring (18%). This result is similar to the fully passive pattern found in Australia, Brazil, Canada, Ireland, Italy, Malaysia, Mexico, New Zealand, Portugal, Qatar, Russia, Spain, Switzerland and the United Arab Emirates (Kassem and Succar 2017).

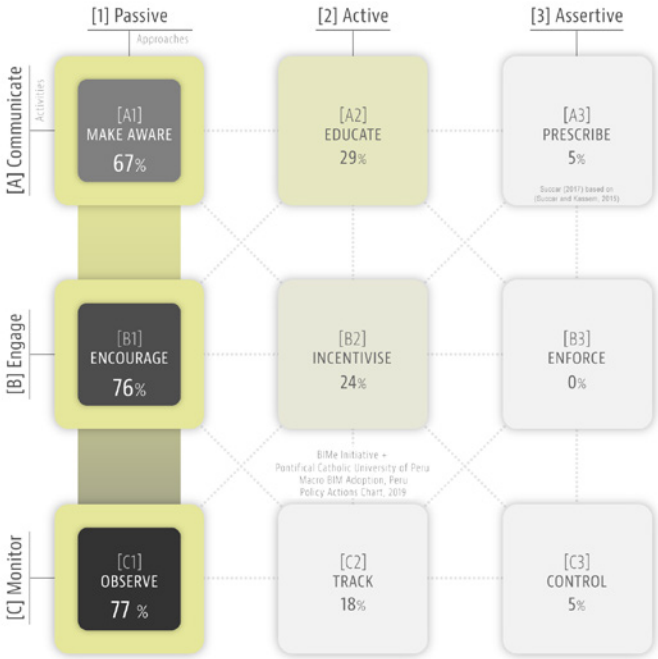


Figure 9: Model D - Results

Some public agencies have organised BIM workshops and seminars with national and international speakers. The objective has been to showcase the BIM initiatives of some public projects and learn from international experiences. Likewise, the Ministry of Housing, Construction and Sanitation have pre-published the "General Guidelines for the use of BIM in construction projects". At the time of writing this report, the guideline is under consultation. The government has also announced BIM as one of the pillars of the "National Competitiveness and Productivity Plan". In the next five years, it is likely that policymakers will exhibit an **active** approach with the development of BIM standards and requirements and a regulatory framework.

MODEL E - MACRO-DIFFUSION RESPONSIBILITIES

This model analyses the diffusion through the roles of industry actors related to the BIM fields (policy, processes, technology). It enables the assessment and comparison of the roles played by different stakeholders in facilitating diffusion in each market.

Table 4: Macro-Diffusion Responsibilities. Source: Succar and Kassem 2015

Actors	Description
[1] Policy makers	Authorities involved in mandating, regulating or facilitating the adoption of BIM (Ministry of Economy and Finance, Ministry of Housing, Construction and Sanitation
[2] Educational institutions	Universities and other learning institutions delivering educational programmes (Universities, SENCICO, etc.)
[3] Industry organisations	Companies using BIM for commercial advantage (Contractors such as Graña y Montero, COSAPI, etc.)
[4] Technology developers	Software, hardware and network providers (Autodesk, Trimble, Graphisoft, etc.)
[5] Technology service providers	Companies that help to bridge the gap between technology providers and end users
[6] Industry associations	Associations representing the interests of their members (CAPECO, CAP, CIP, etc.)
[7] Communities of Practice	User groups with a common interest in the use of tools and processes (Peruvian BIM Committee)

The level of involvement to facilitate BIM diffusion of this group of stakeholders were assessed by the experts as, 0 = Low; 1 = Medium Low; 2 = Medium; 3 = Medium High; 4 = High. The panel of experts reached the consensus shown in Table 7 and Figure 10.

Table 7: Macro-Diffusion Responsibilities. Results

Component	Consensus	Assessment
[1]Policy makers	1	Medium Low
[2] Educational institutions	2	Medium
[3] Industry organisations	3	Medium High
[4]Technology developers	3	Medium High
[5] Technology service	2	Medium
[6]Industry associations	2	Medium
[7] Communities of Practice	2	Medium

The stakeholders with the highest rating (Medium High) were the **"Industry organisations"** (contractors) and **"Technology developers"**. This result is consistent with models C and B, as contractors have initiated BIM diffusion and have exerted pressures on clients, other contractors, and small firms. In addition, the technology infrastructure for modelling and collaboration is available in the market.

The stakeholders with intermediate rating (Medium) were the **"Educational institutions"**, **"Technology service providers"**, **"Industry associations"** and **"Communities of Practice"**. Finally, "**Policy makers**" was rated as "Medium Low". With the advent of the National BIM Plan of the Ministry of Economy and Finance, this result may change in future versions of this study.

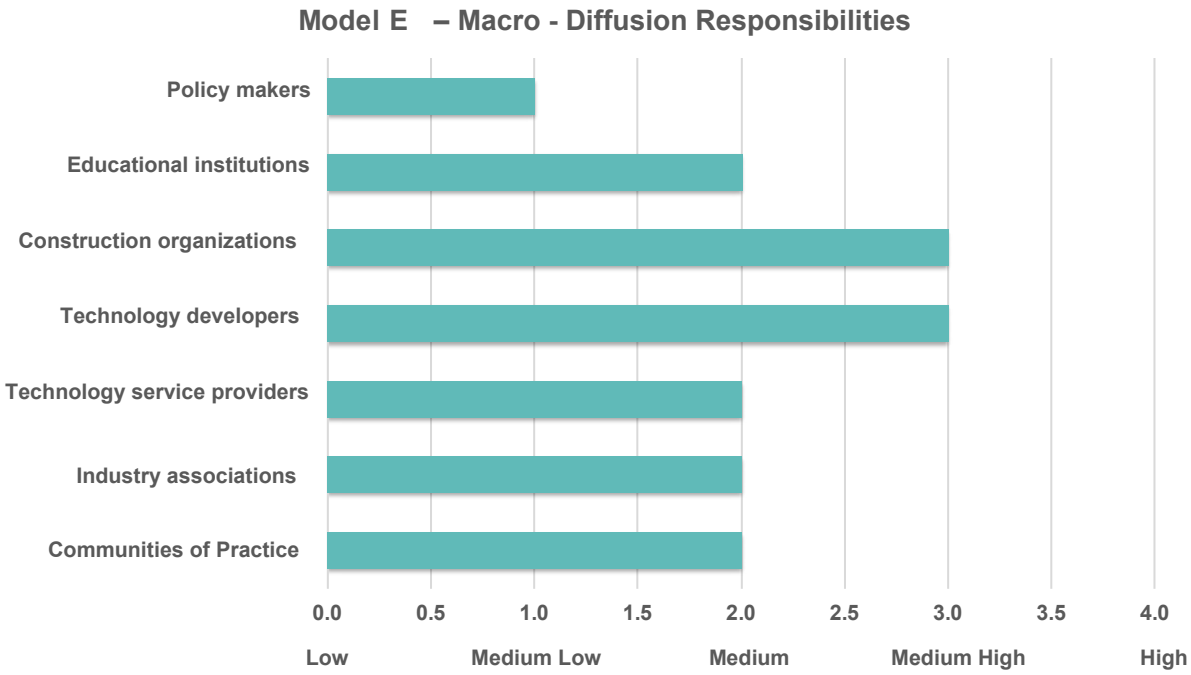


Figure 10: Macro-Diffusion Responsibilities. Results

CONCLUSIONS

BIM has been used for approximately 10 years in the Peruvian construction industry. This is the first Macro Adoption study conducted in Peru. The results of this report are timely in light of the publication of the "National Competitiveness and Productivity Plan" led by the Ministry of Economy and Finance, which includes BIM as a strategic pillar.

The findings of this report confirm the predominant role of general contractors for BIM implementation and evidence of the government transition to influence industry through policy-making. The niche of BIM users and firms in the market have developed skills with modelling and collaboration software and processes, however, they are limited to the design and construction phases. Moreover, the collaboration processes still need more development in order to create native digital information. As an industry, we need to more forward to integrate information in common data environments and across the project lifecycle. If the public sector wants to maximise investments, the use of BIM should be considered "from the formulation, evaluation, execution and operation of projects" (Ministry of Economy and Finance 2019).

The study has found that current policymakers have a passive approach to BIM. However, the new active approach of the government will allow to development of some macro maturity components such as objectives, stages and milestones; regulatory framework; and noteworthy publications (guides, standards, mandates). Universities and BIM consultants has a fundamental role in training new professionals, but also in the development of training programmes to experienced public servants. Technical institutions such as SENCICO could incorporate BIM into their courses to meet the demand for BIM modelers that the market will require; whilst universities should train BIM-educated construction managers. In addition, the academia should promote research deliverables, such as thesis, academic publications, case study reports, adoption studies, among others.

Subcontractors and suppliers could create 3D objects based of their products. This will allow the creation of projects with standardised elements that facilitate productivity in the management of design, construction and operation, using BIM. Finally, industry and professional associations should engage more with BIM in order stimulate diffusion among their members and to meet the professional challenges of the 21st century.

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