Macro-BIM adoption: Diffusion of Innovation within Markets and across Countries

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This 15 minutes presentation is in three parts:

Part 1: research objectives + research background

Part 2: macro adoption models + data collected to date

Part 3: summary of findings + future research

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Research Objectives + Research Background

Macro-BIM adoption:
Diffusion of Innovation within Markets and across Countries

What is Macro BIM Adoption?

Macro BIM Adoption refers to the *implementation* and *diffusion* of Building Information Modelling (BIM) within and across markets.

BIM here refers to the *current expression of digital innovation* within the construction industry, a combination of *technologies*, *processes* and *policies*.

Macro-BIM adoption:
Diffusion of Innovation within Markets and across Countries

Research Objectives

Research Objectives:

Generate new models, tools and templates for assessing and improving BIM adoption policies

Collect data and generate benchmarks to clarify market adoption rates and how it can be improved

Encourage collaboration between policy makers, researchers and industry associations across markets

Macro-BIM adoption:
Diffusion of Innovation within Markets and across Countries

Research Background

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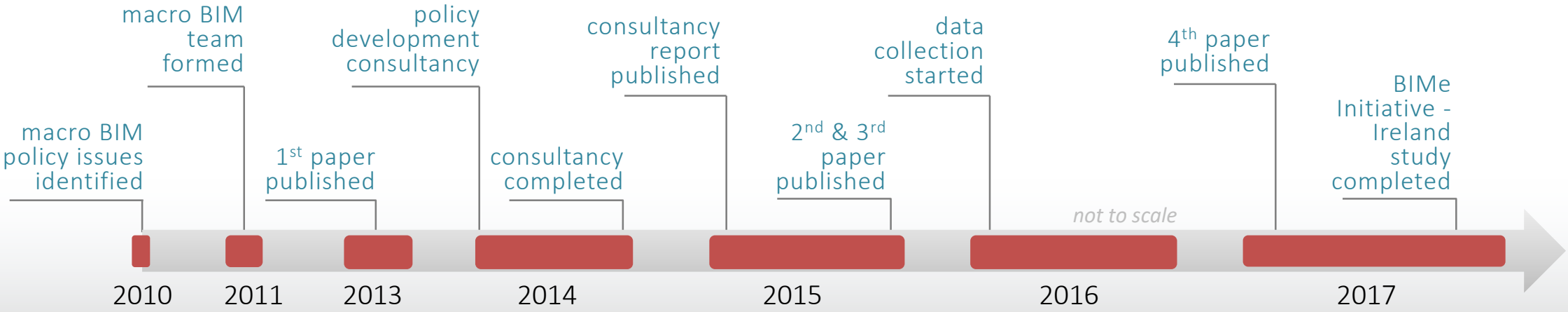
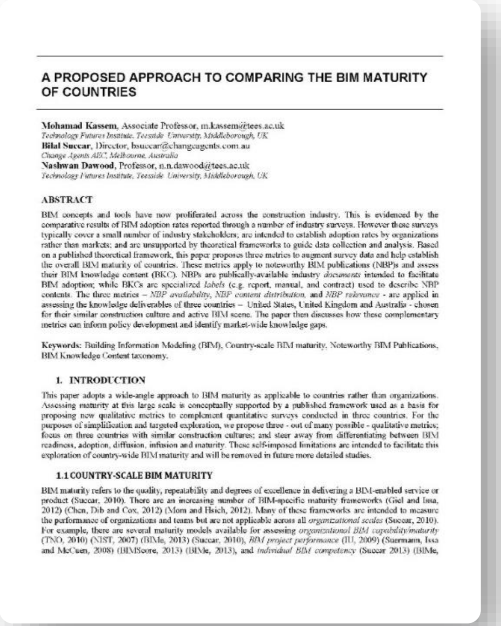


A Proposed Approach To Comparing the BIM Maturity of Countries



A PROPOSED APPROACH TO COMPARING THE BIM MATURITY OF COUNTRIES

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ABSTRACT

BIM concepts and tools have now proliferated across the construction industry. This is evidenced by the comparative results of BIM adoption rates reported through a number of industry surveys. However these surveys typically cover a small number of industry stakeholders; are intended to establish adoption rates by organizations rather than markets; and are unsupported by theoretical frameworks to guide data collection and analysis. Based on a published theoretical framework, this paper proposes three metrics to augment survey data and help establish the overall BIM maturity of countries. These metrics apply to noteworthy BIM publications (NBP)s and assess their BIM knowledge content (BKC). NBPs are publically-available industry *documents* intended to facilitate BIM adoption; while BKCs are specialized *labels* (e.g. report, manual, and contract) used to describe NBP contents. The three metrics – *NBP availability, NBP content distribution,* and *NBP relevance* - are applied in assessing the knowledge deliverables of three countries – United States, United Kingdom and Australia - chosen for their similar construction culture and active BIM scene. The paper then discusses how these complementary metrics can inform policy development and identify market-wide knowledge gaps.

Keywords: Building Information Modeling (BIM), Country-scale BIM maturity, Noteworthy BIM Publications, BIM Knowledge Content taxonomy.

1. INTRODUCTION

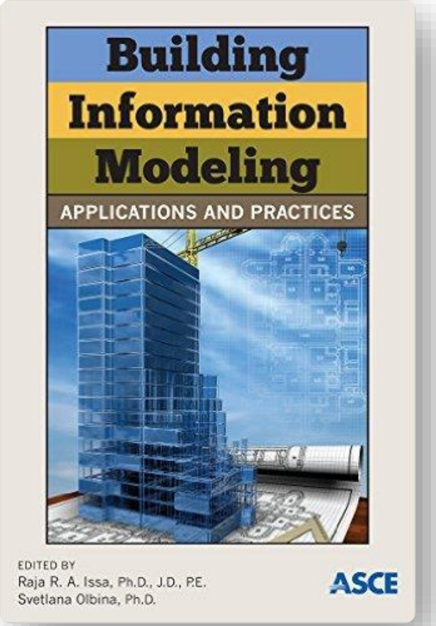
This paper adopts a wide-angle approach to BIM maturity as applicable to countries rather than organizations. Assessing maturity at this large scale is conceptually supported by a published framework used as a basis for proposing new qualitative metrics to complement quantitative surveys conducted in three countries. For the purposes of simplification and targeted exploration, we propose three - out of many possible - qualitative metrics; focus on three countries with similar construction cultures; and steer away from differentiating between BIM readiness, adoption, diffusion, infusion and maturity. These self-imposed limitations are intended to facilitate this exploration of country-wide BIM maturity and will be removed in future more detailed studies.

1.1 COUNTRY-SCALE BIM MATURITY

BIM maturity refers to the quality, repeatability and degrees of excellence in delivering a BIM-enabled service or product (Succar, 2010). There are an increasing number of BIM-specific maturity frameworks (Giel and Issa, 2012) (Chen, Dib and Cox, 2012) (Mom and Hsich, 2012). Many of these frameworks are intended to measure the performance of organizations and teams but are not applicable across all *organizational scales* (Succar, 2010). For example, there are several maturity models available for assessing *organizational BIM capability/maturity* (TNO, 2010) (NIST, 2007) (BIMe, 2013) (Succar, 2010), *BIM project performance* (IU, 2009) (Suermann, Issa and McCuen, 2008) (BIMScore, 2013) (BIMe, 2013), and *individual BIM competency* (Succar 2013) (BIMe,

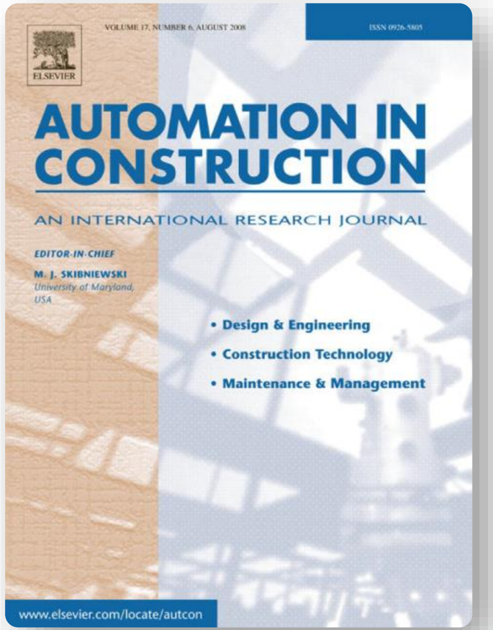
2013

Analyzing Noteworthy Publications of Eight Countries Using a Knowledge Content Taxonomy



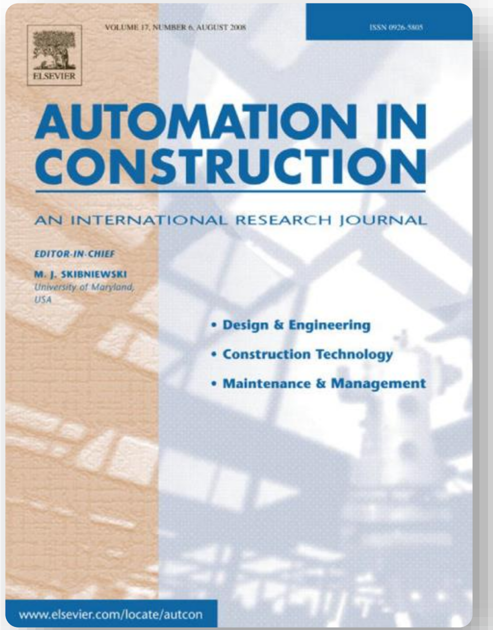
2015

Macro BIM Adoption: Conceptual Structures



2015

Macro BIM adoption: Comparative Market Analysis



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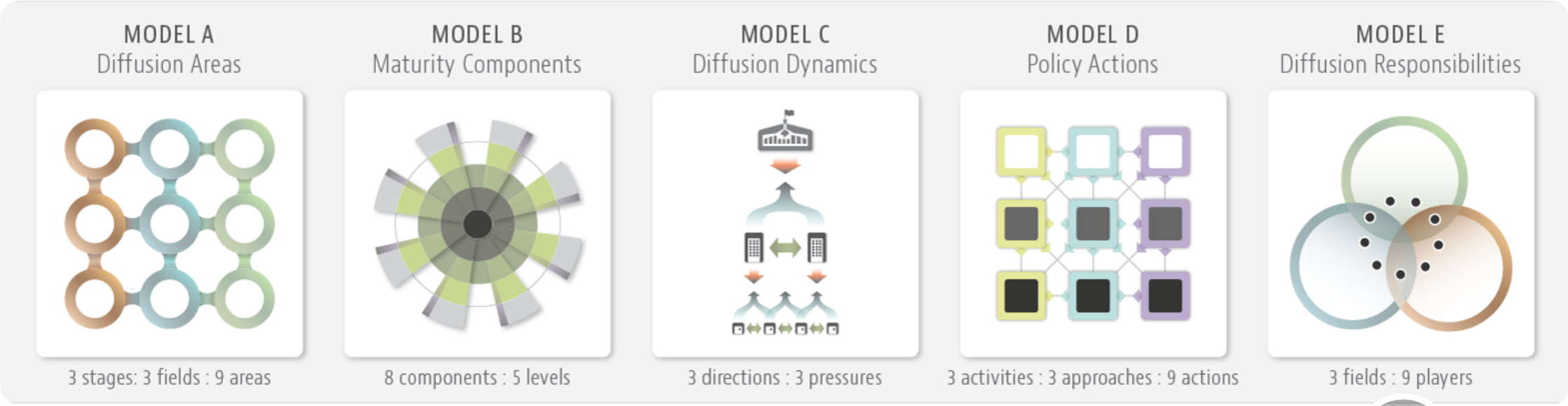
Macro Adoption models + data collected to date



Macro Adoption Models

video available

Initial Benchmarking Data – collected in 2015 from

20 countries and 95 experts

Country	No.	Country	No.	Country	No.	Country	No.
Australia	4	New Zealand	3	Netherlands	4	Switzerland	2
China	3	Brazil	4	Portugal	9	UAE	3
Finland	5	Ireland	3	Qatar	6	United Kingdom	16
Hong Kong	3	Italy	5	Russia	2	USA	5
Malaysia	4	Mexico	3	Spain	7	South Korea	4

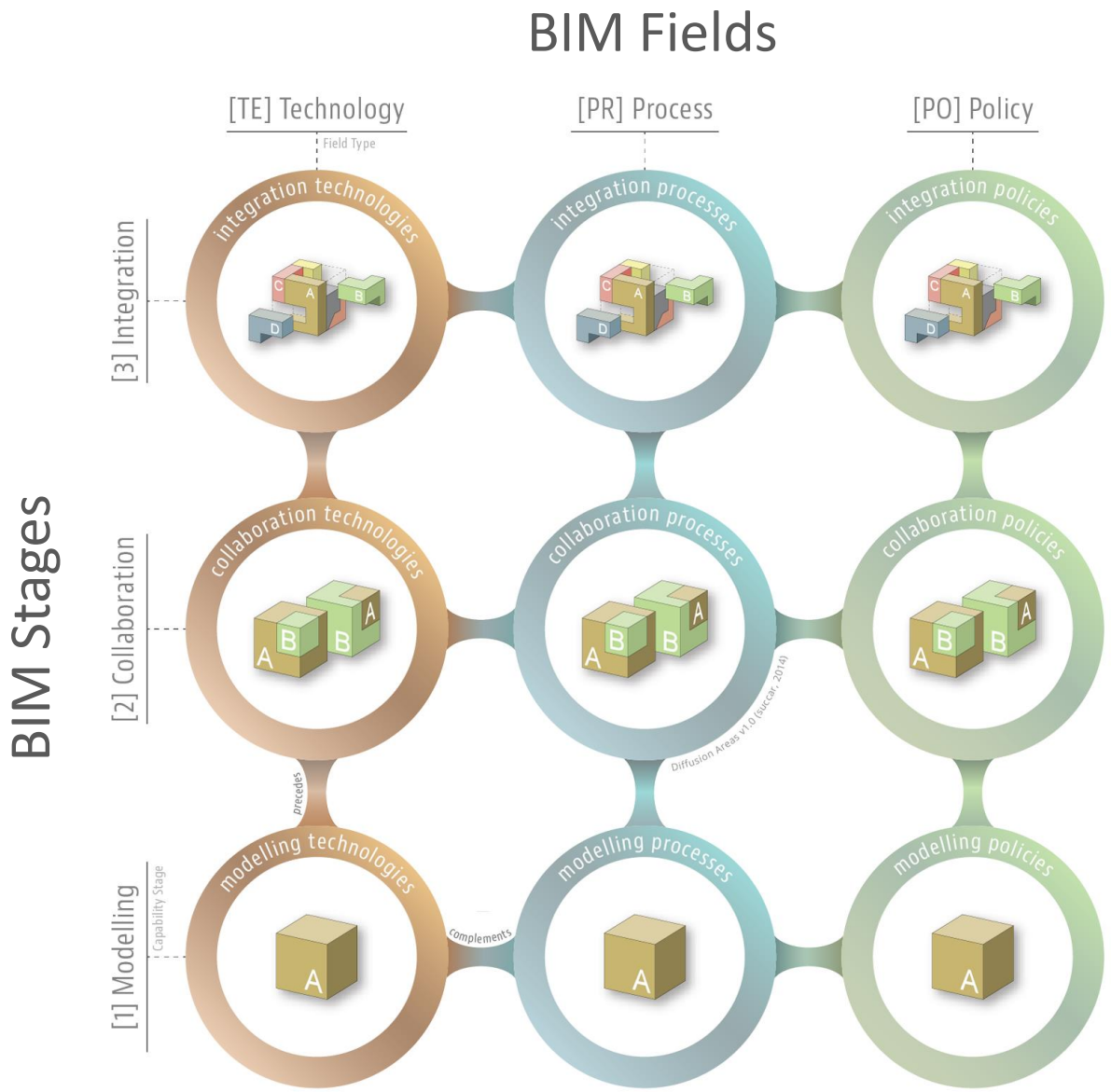
Macro-BIM adoption:
Diffusion of Innovation within Markets and across Countries

Diffusion Areas Model

Diffusion Areas Model

clarifies the *extent of* BIM diffusion across a market by overlaying:

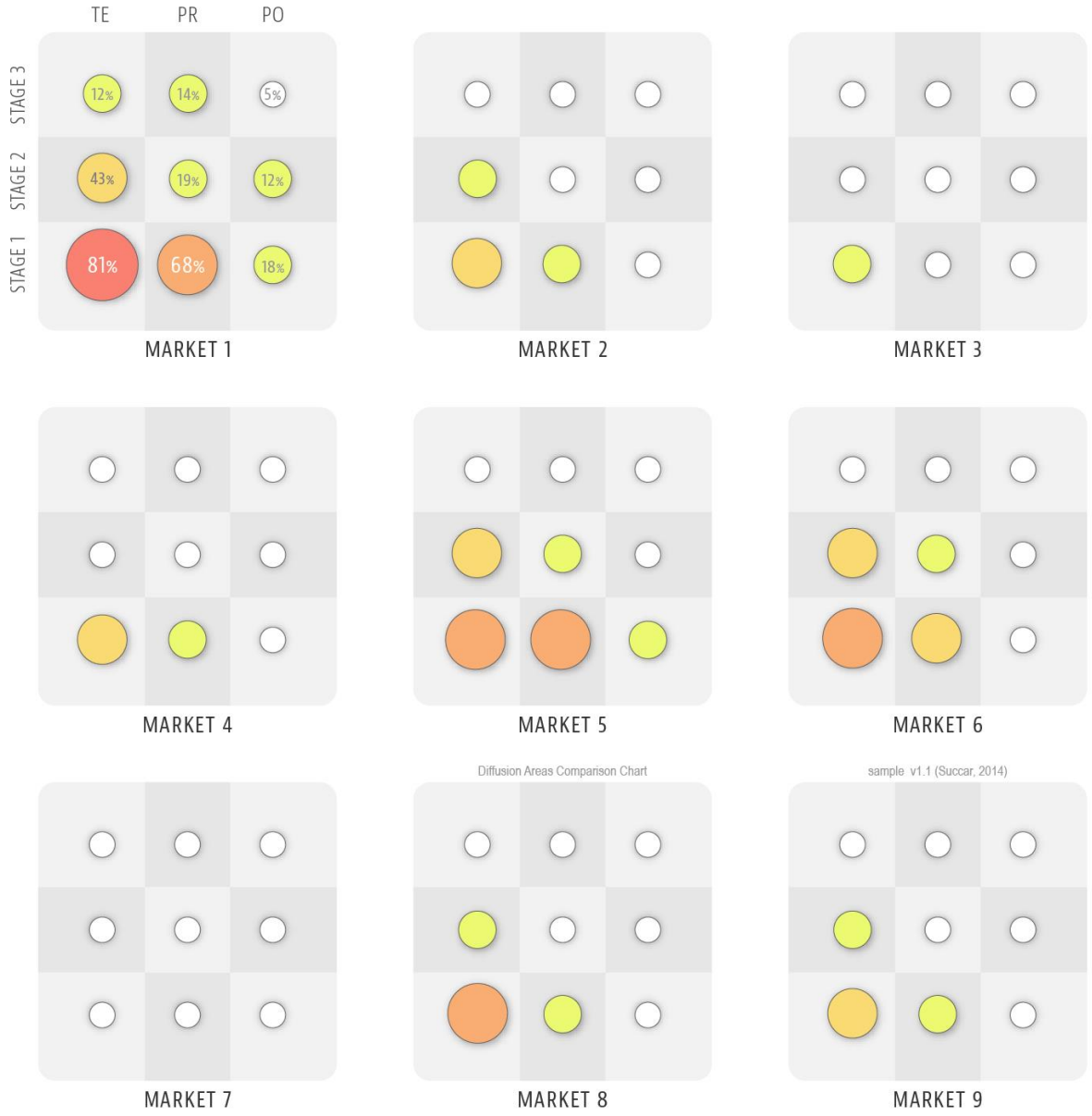
BIM Fields
(Technology, Process, and Policy) *with*
BIM Stages
(Modelling, Collaboration & Integration)



comparative

Diffusion Areas Charts

clarifying the distribution of BIM diffusion ratings within different *sample* markets

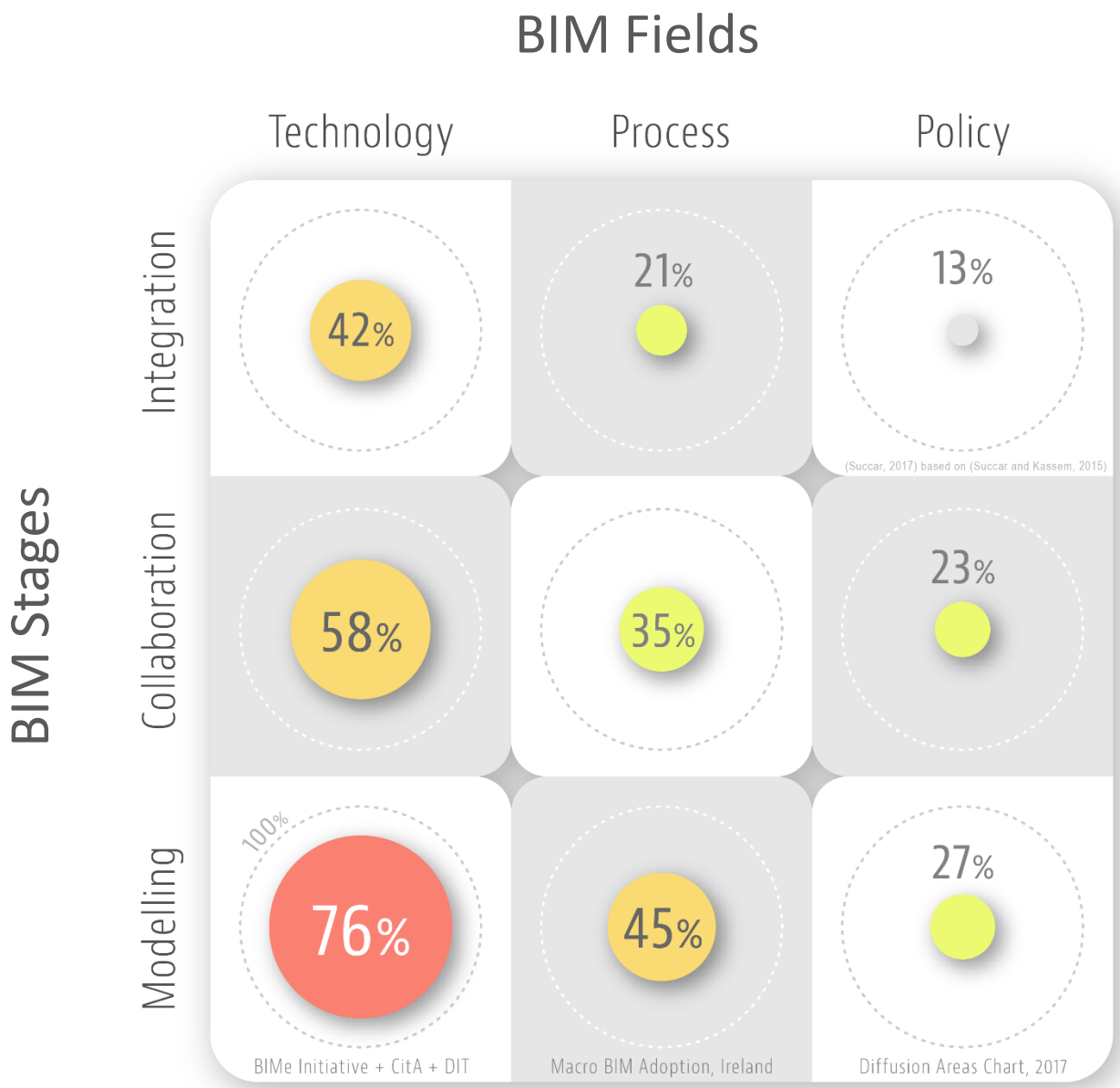


Diffusion Areas Chart

clarifying BIM diffusion within a market

Ireland 2017

Macro BIM Adoption Snapshot
conducted in collaboration with CitA and DIT



Macro-BIM adoption:
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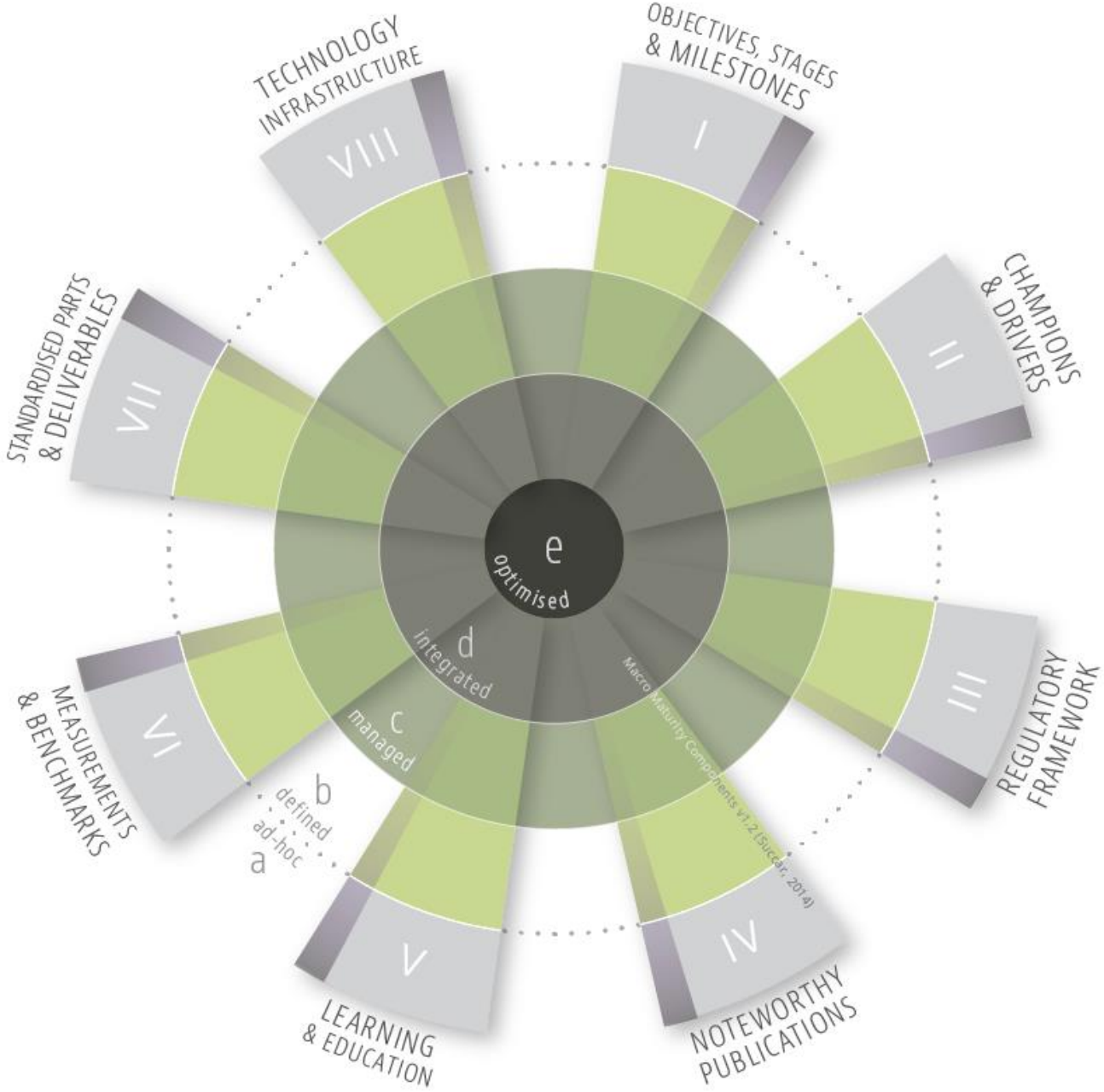
Maturity Components Model

Macro Maturity Components Model

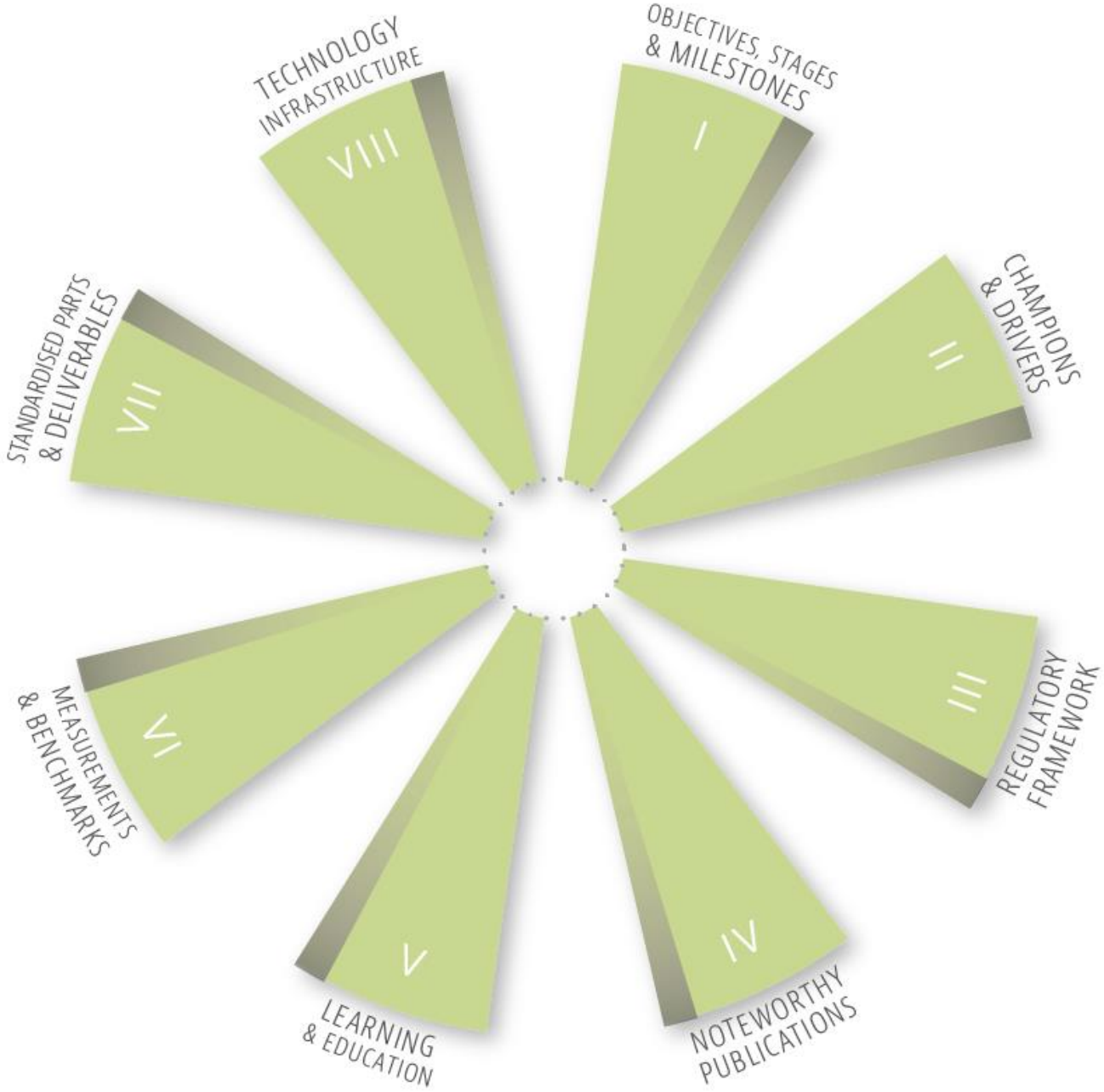
Measures BIM Maturity
across markets using
8 maturity components and
5 maturity levels



Macro Maturity Components Model

the eight

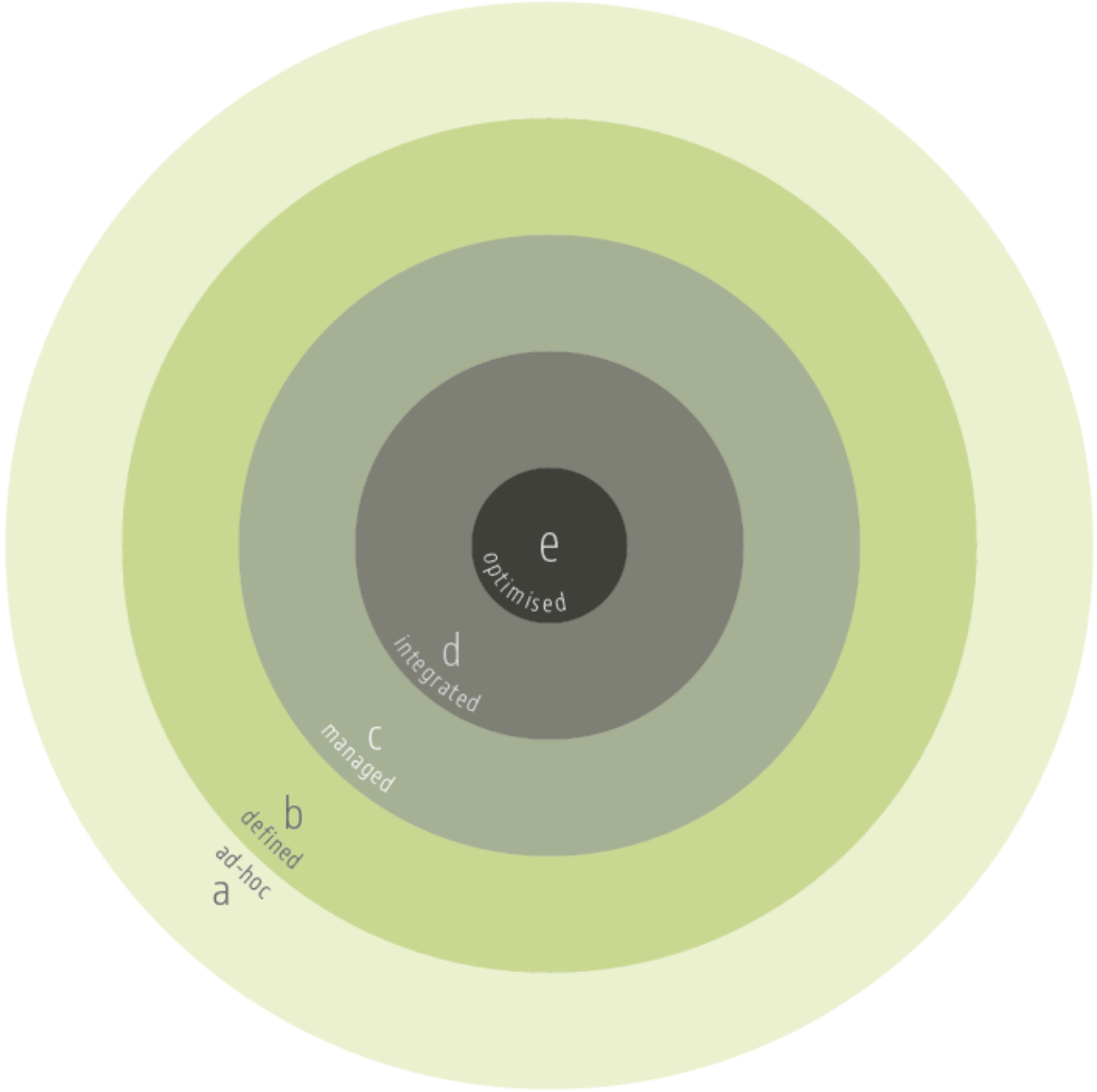
Maturity Components



Macro Maturity Components Model

the five

Maturity Levels



Macro Maturity Components Model

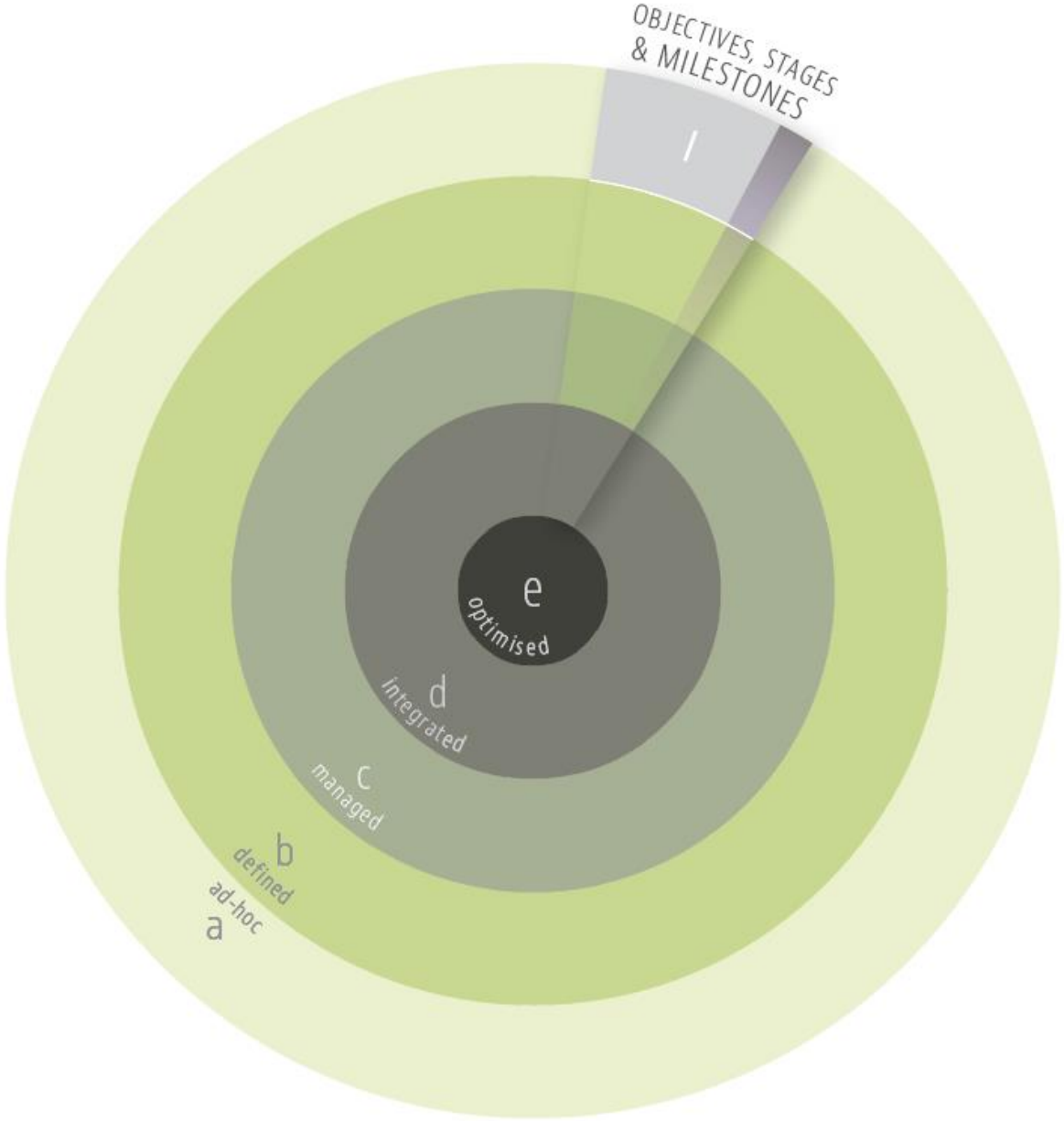
the eight

Maturity Components

+

the five

Maturity Levels



Macro Maturity Components Model

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Maturity Components

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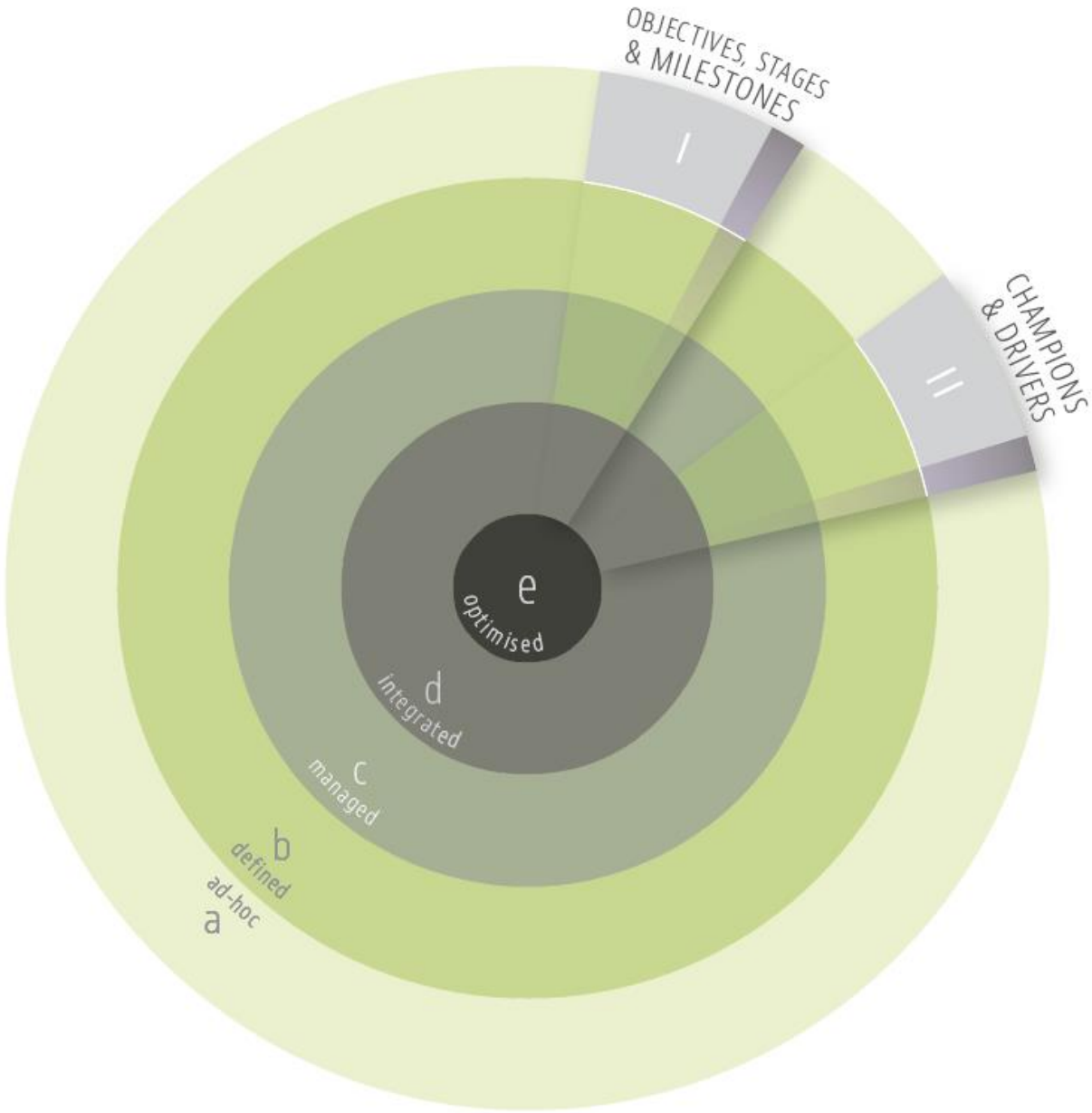
Maturity Levels



Macro Maturity Components Model

the eight

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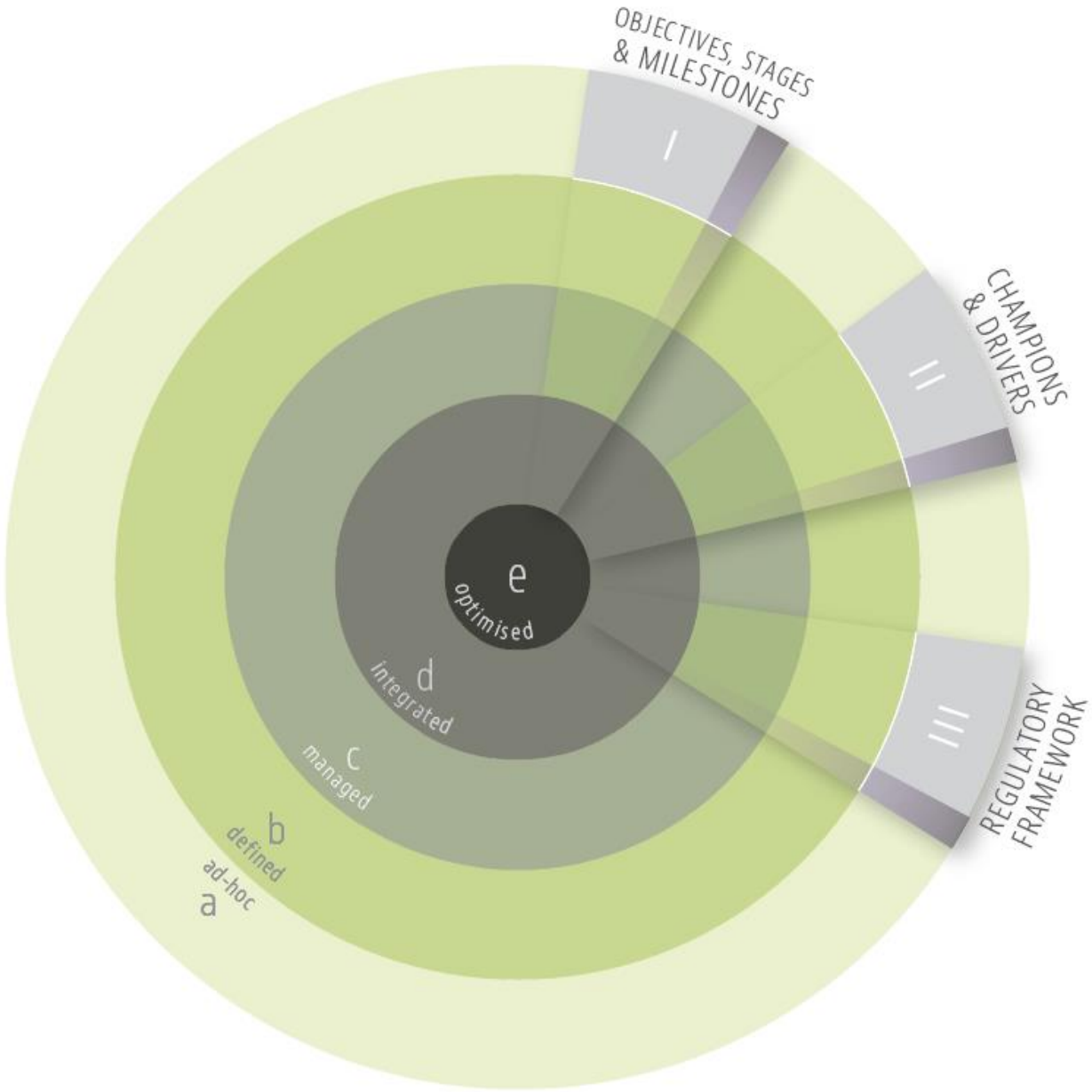

Macro Maturity Components Model

the eight

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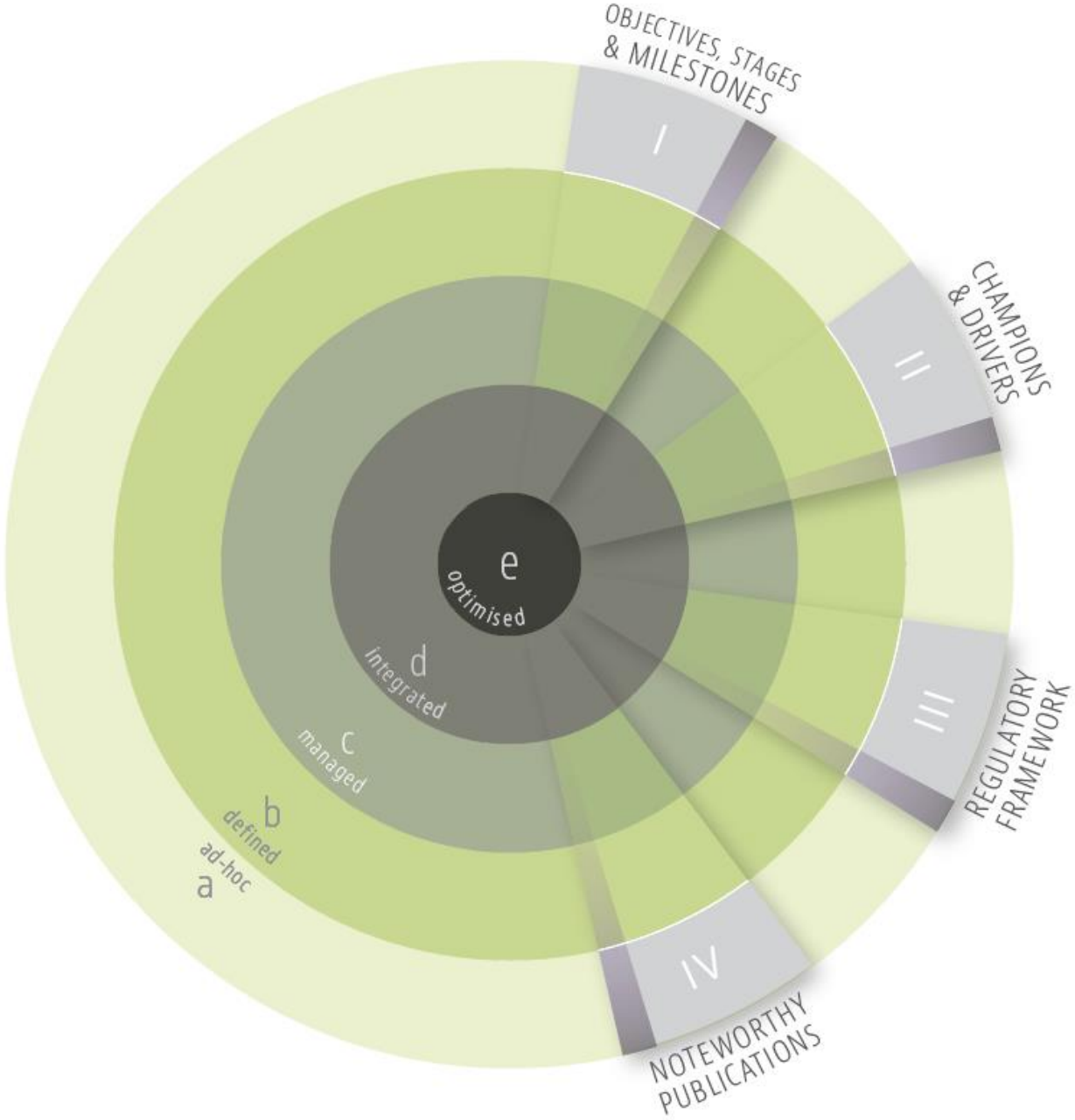

Macro Maturity Components Model

the eight

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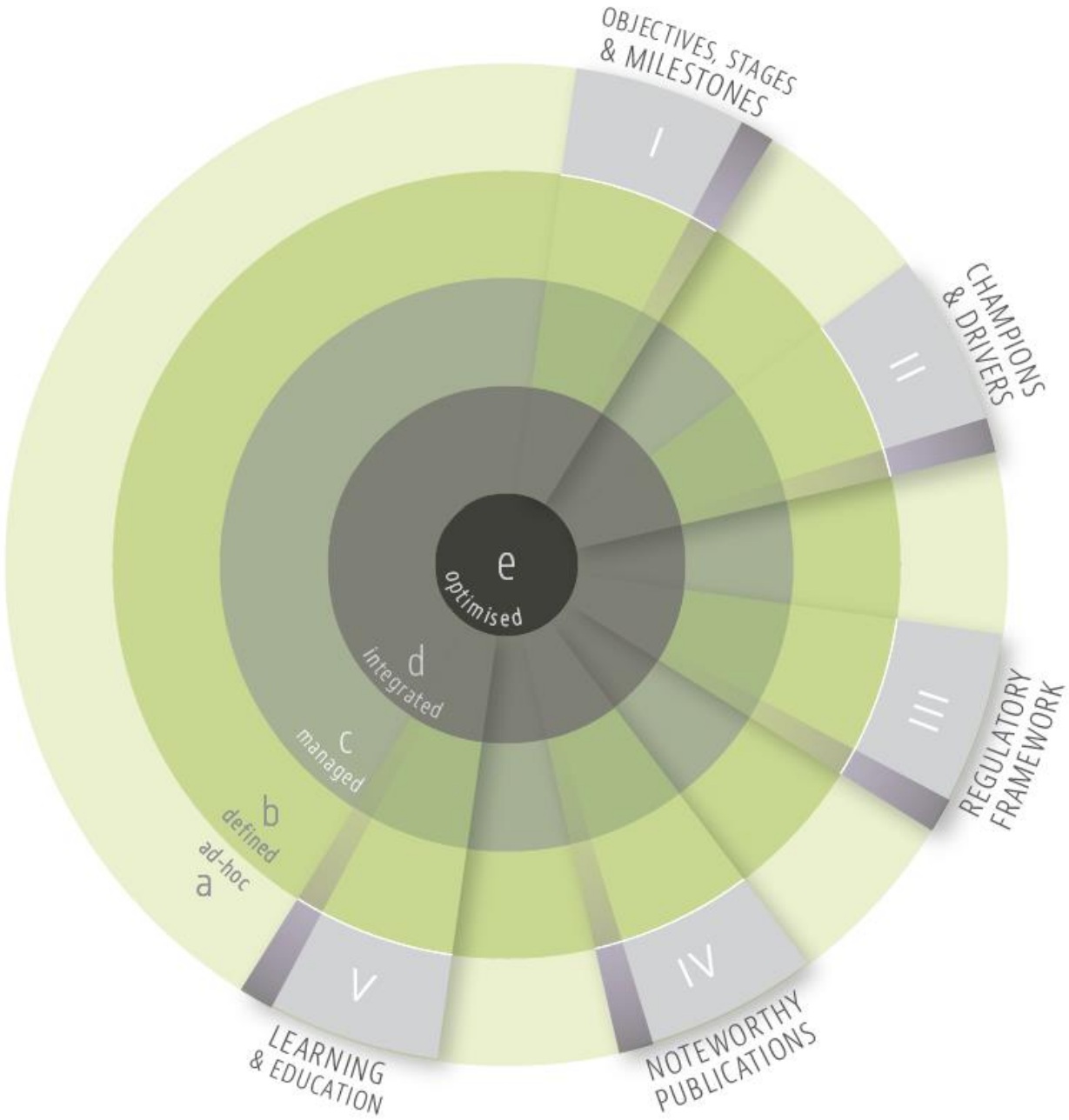

Macro Maturity Components Model

the eight

Maturity Components

+

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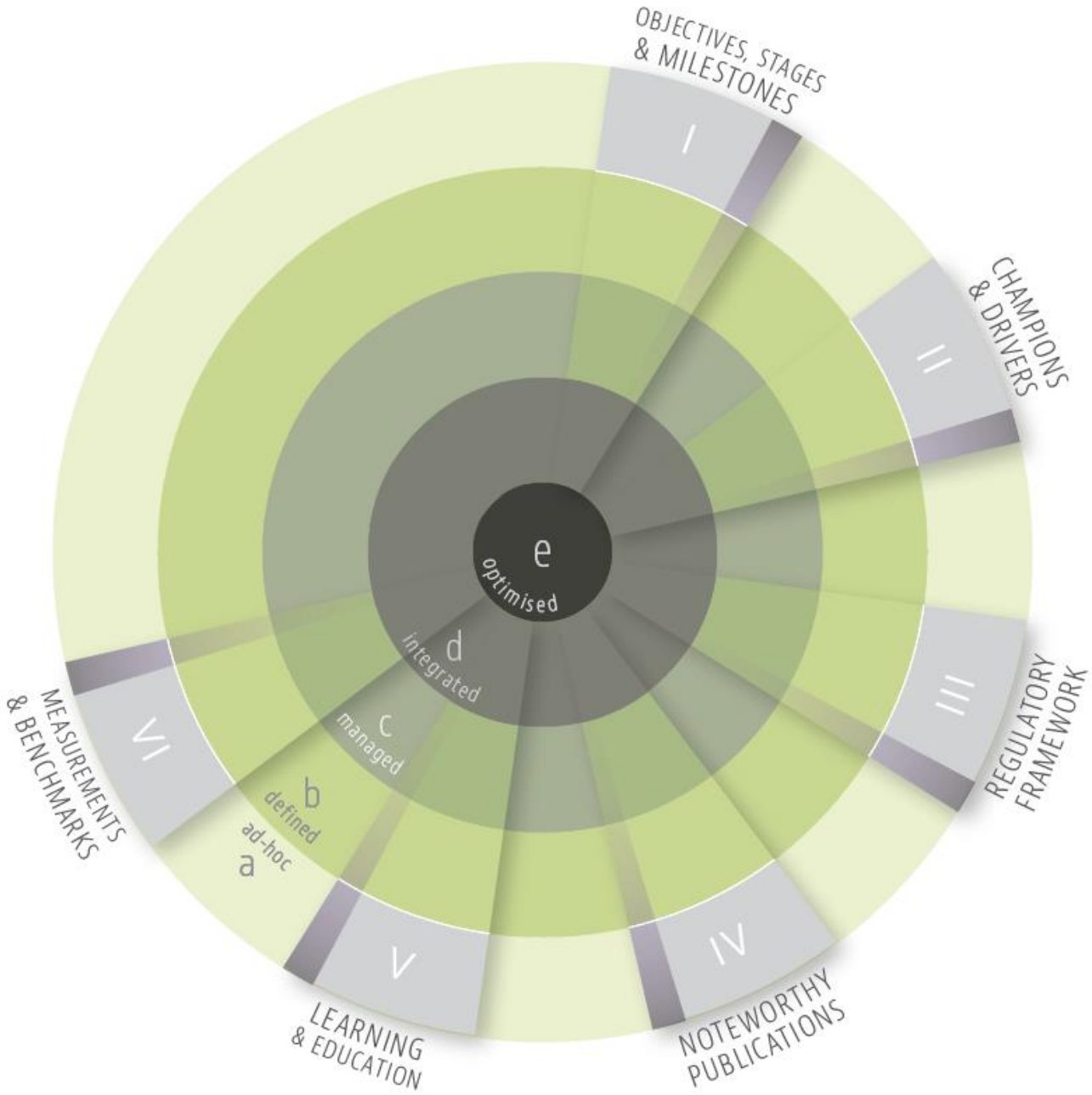
Maturity Levels



Macro Maturity Components Model

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Maturity Components

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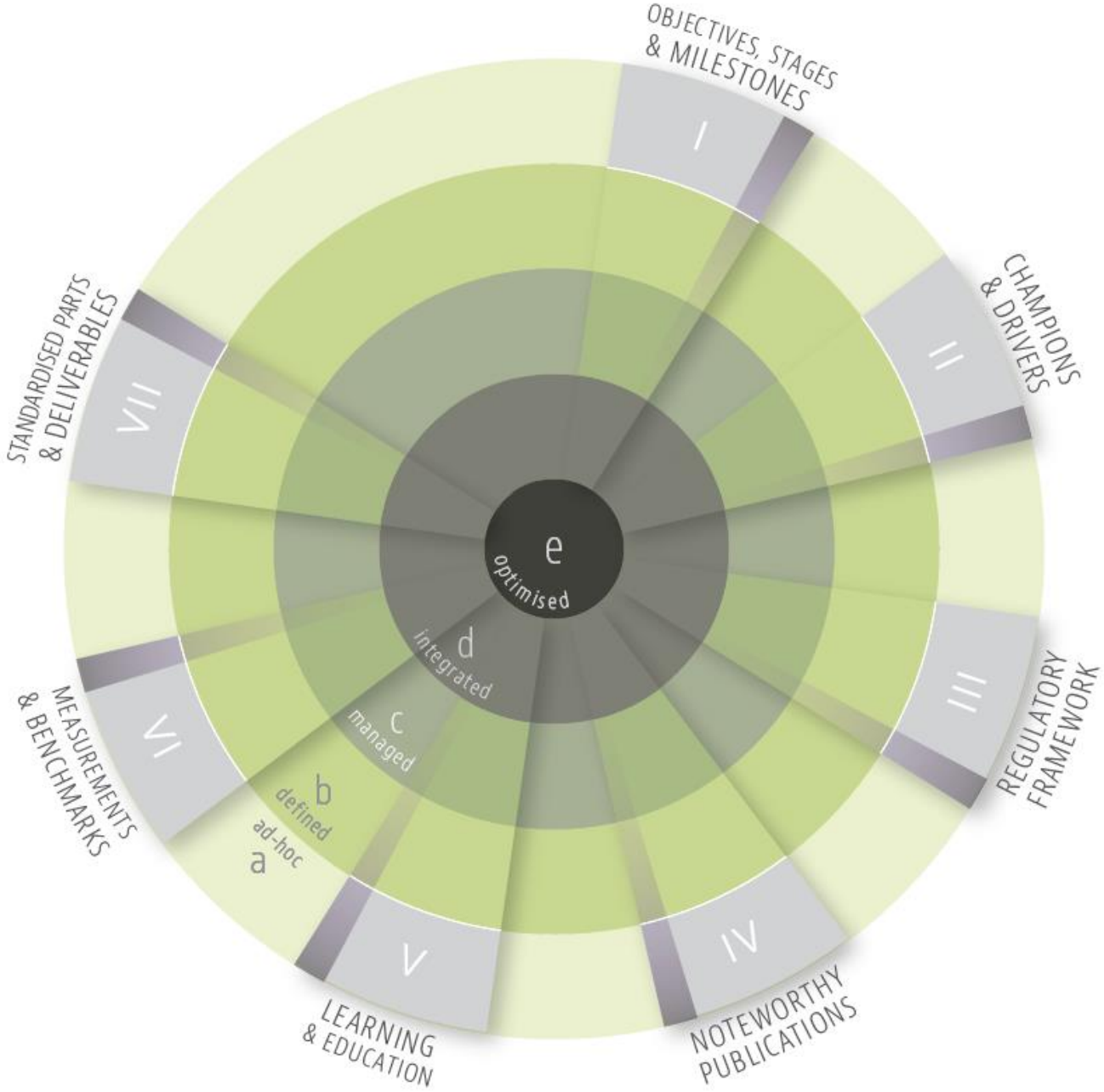

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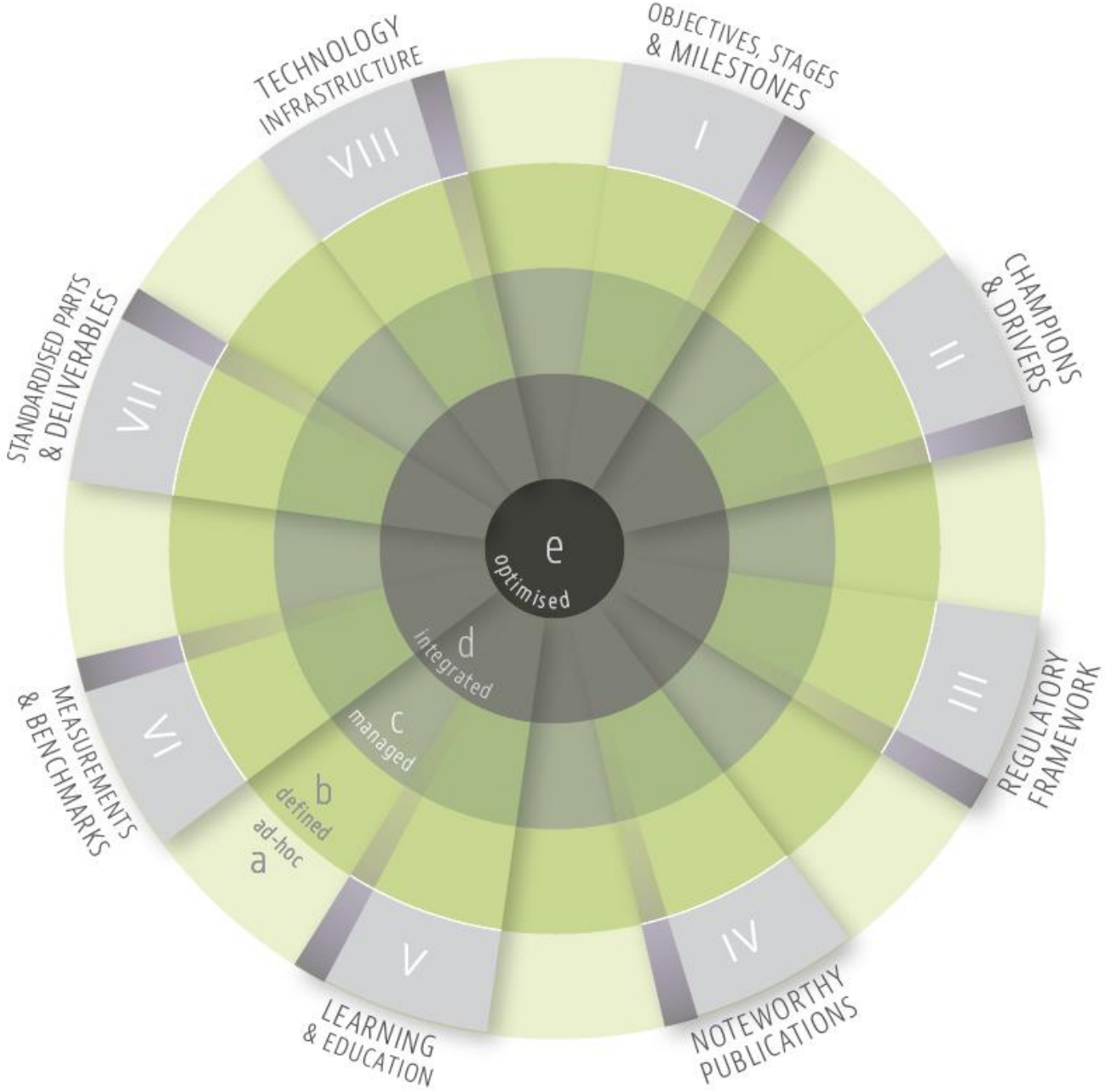
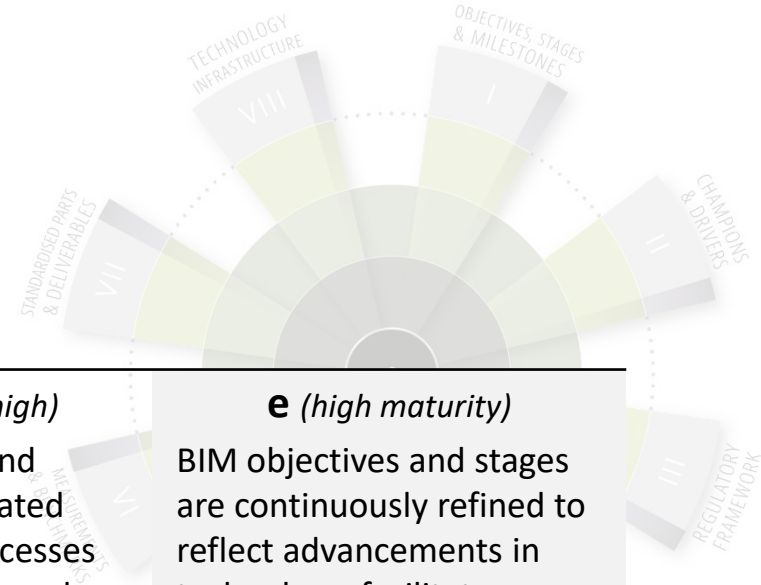


Component I

Objectives, stages and milestones

latest version or additional information



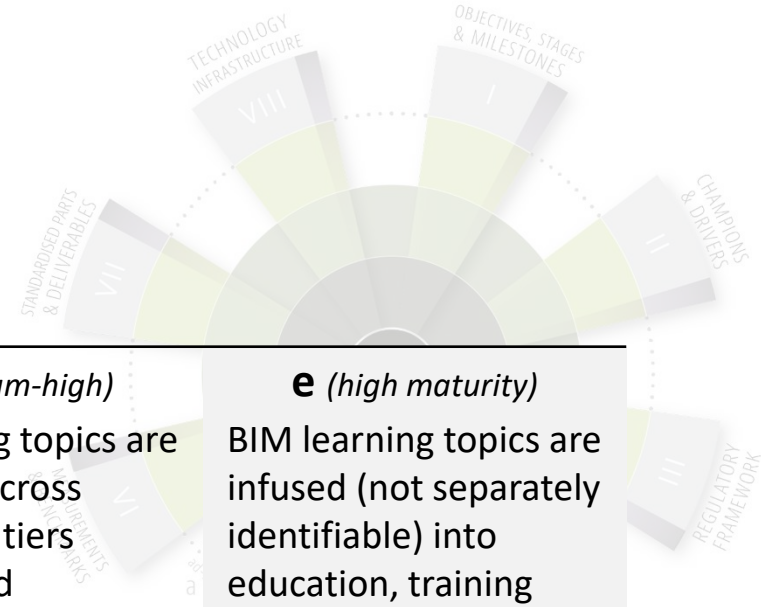
a *(low maturity)*	**b** *(medium-low)*	**c** *(medium maturity)*	**d** *(medium-high)*	**e** *(high maturity)*
There are no market-scale BIM objectives or well-defined BIM implementation stages or milestones	There are well-defined macro BIM objectives, implementation milestones and capability stages	BIM objectives, stages and milestones are centrally managed and formally monitored	BIM objectives and stages are integrated into policies, processes and technologies and manifest themselves within all other macro maturity components	BIM objectives and stages are continuously refined to reflect advancements in technology, facilitate process innovation, and benefit from international best practices

Other component-specific metrics include: *The Availability of Long-term Objectives to Guide Market Adoption; Availability of Capability Stages to Guide Market Adoption; The Availability of Maturity Milestones to Guide Market Adoption; …*

Component V

Learning and education

latest version or additional information



a *(low maturity)*	**b** *(medium-low)*	**c** *(medium maturity)*	**d** *(medium-high)*	**e** *(high maturity)*
BIM learning topics are neither identified nor included within legacy education/training programs; learning providers lack the ability to deliver BIM-infused education	BIM learning topics are identified and introduced into education/training programs; BIM learning providers are available across a number of disciplines and specialties	BIM learning topics are mapped to current and emergent roles; BIM learning providers deliver accredited programs across disciplines and specialties	BIM learning topics are integrated across educational tiers (tertiary, and vocational) and address the learning requirements of all industry stakeholders	BIM learning topics are infused (not separately identifiable) into education, training and professional development programs

Other component-specific metrics include: *BIM Infusion into Tertiary Curricula; Multi-disciplinary Integration of Curricula; Use of Simulated Design, Construction and Operation Environments; Expertise of Learning Providers; …*

Component VII

Standardised parts and deliverables

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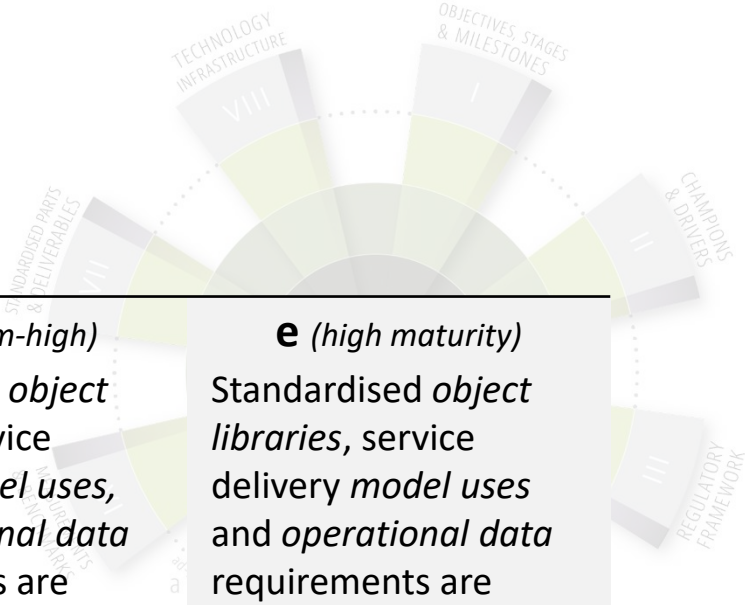


a *(low maturity)*	**b** *(medium-low)*	**c** *(medium maturity)*	**d** *(medium-high)*	**e** *(high maturity)*
There no market-specific *object libraries* (e.g. doors and windows); service delivery *model uses* (e.g. clash detection) and *operational data* requirements (e.g. COBie)	*Object libraries* are available yet follow varied modelling and classification norms; service delivery *model uses* and *operational data* requirements are informally defined and partially used	Standardised *object libraries* are available and used; service delivery *model uses* and *operational data* requirements are formally defined and used across all project lifecycle phases	Standardised *object libraries*, service delivery *model uses,* and *operational data* requirements are integrated into, procurement mechanisms, project workflows and lifecycle facility operations	Standardised *object libraries*, service delivery *model uses* and *operational data* requirements are continuously optimised and realigned to improve usage, accessibility, interoperability and connectivity

Other component-specific metrics include: *Availability of an Elemental Classification System; Availability of National Object Libraries; Availability of Standardised Model Uses; …*

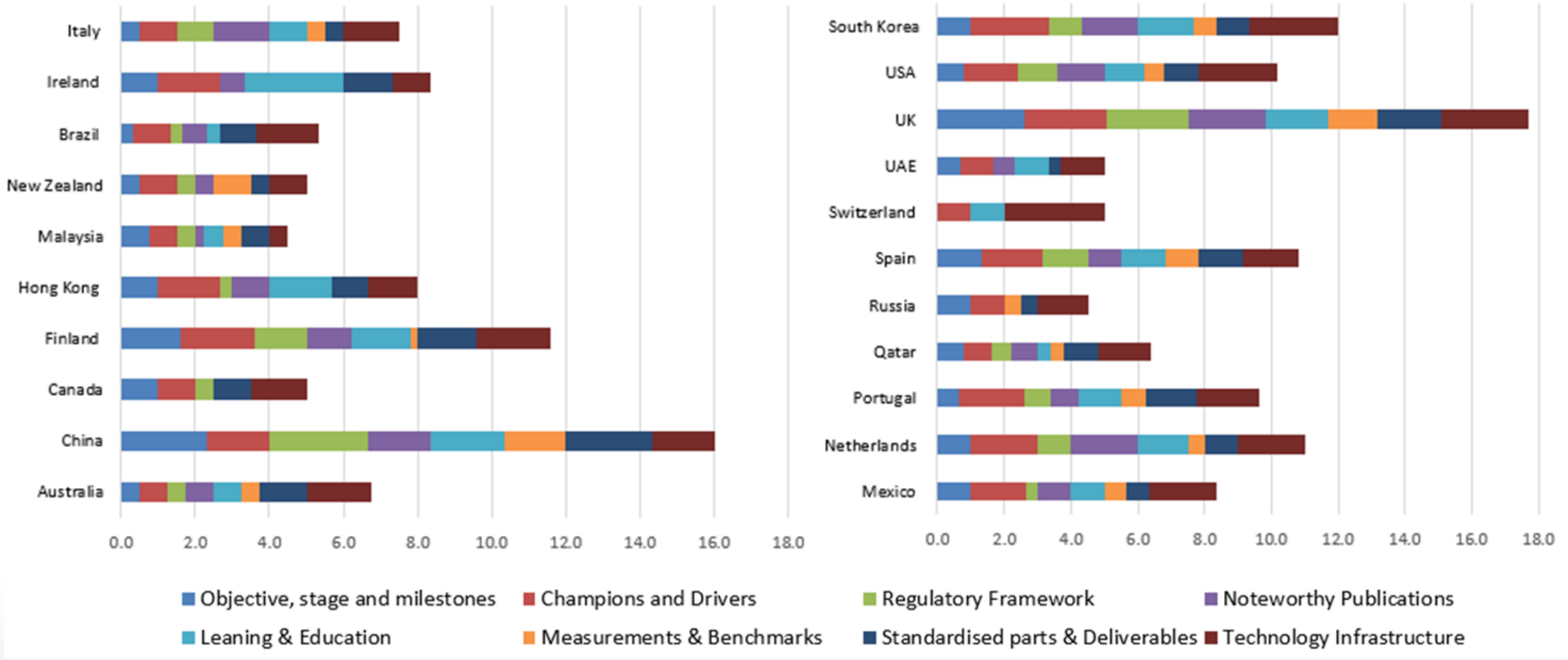
Macro Maturity Components Charts

Compares BIM Maturity across *sample* markets using the 8 maturity components and 5 maturity levels

MARKET 1

MARKET 2

latest version: http://bit.ly/MacroMC



Comparative rating of macro maturity across the 2015 sample

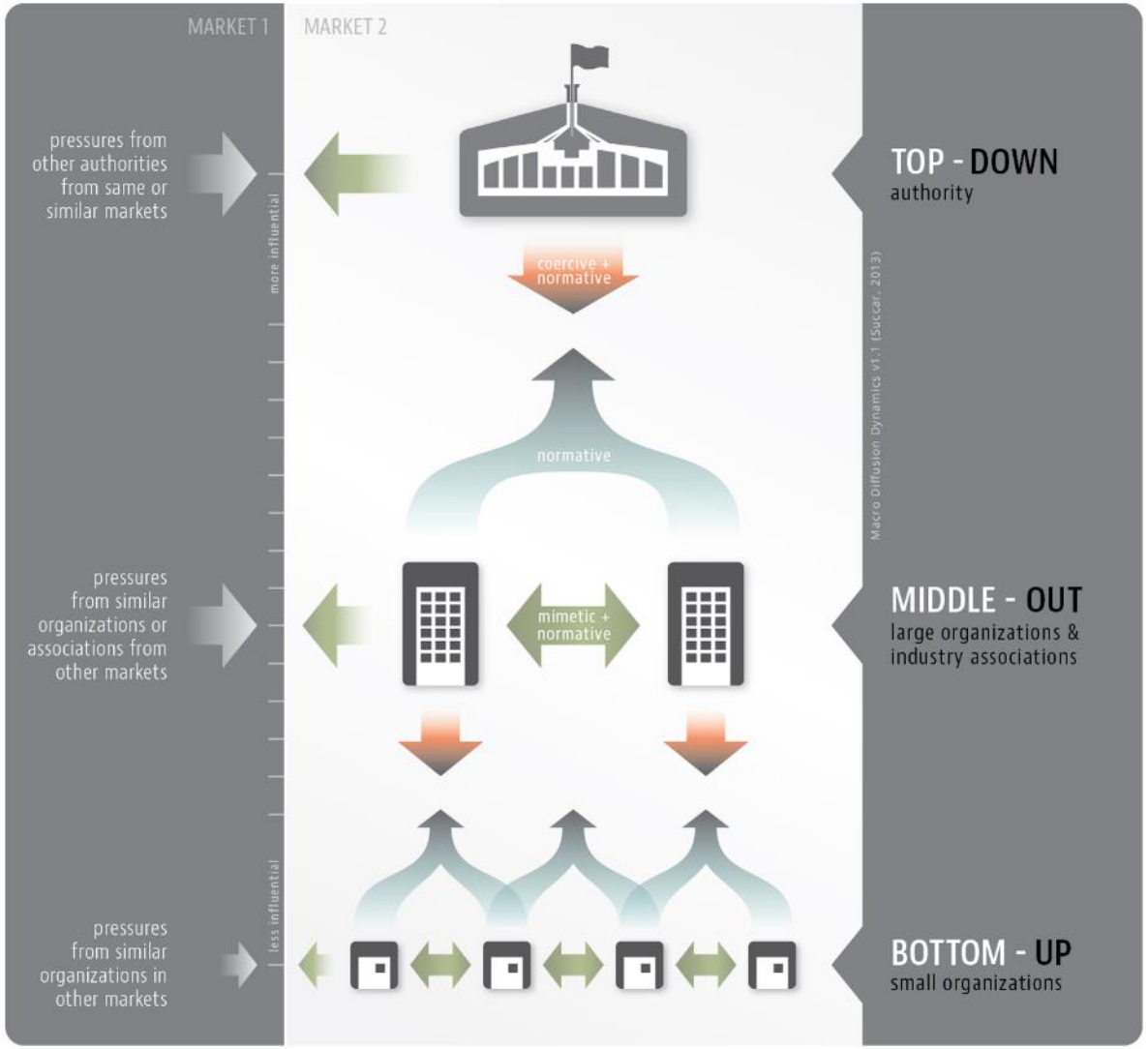
Macro-BIM adoption:
Diffusion of Innovation within Markets and across Countries

Diffusion Dynamics Model

Diffusion Dynamics Model

clarifies the *how* BIM diffuses within and across markets

The model includes:
3 Diffusion Dynamics:
Top-Down, Middle-Out & Bottom-Up.
3 Pressure Mechanisms:
Downwards, Upwards & Horizontal; and
3 Pressure Types:
Coercive, Normative, & Mimetic



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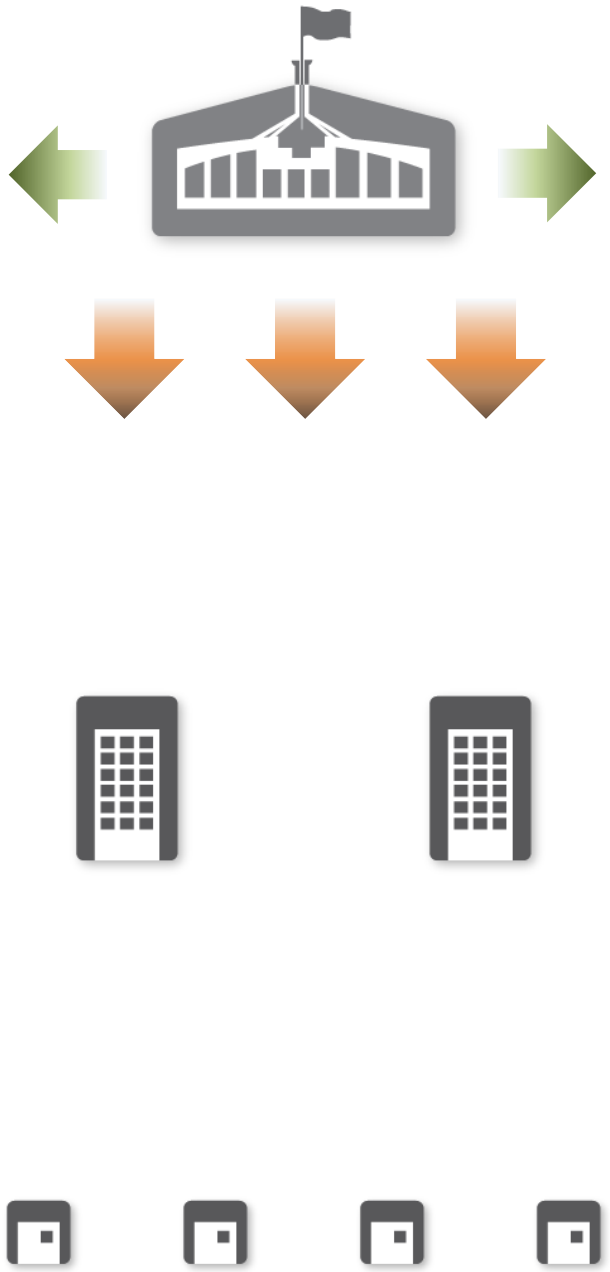

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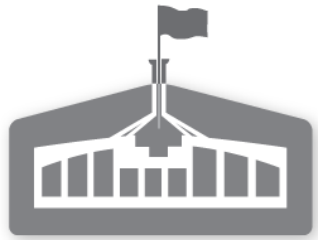
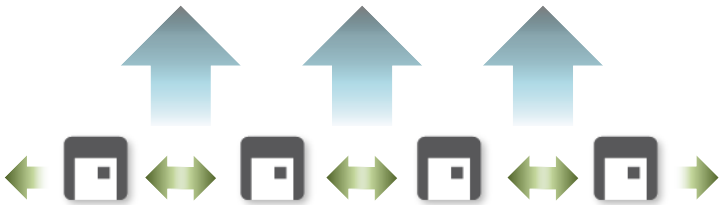


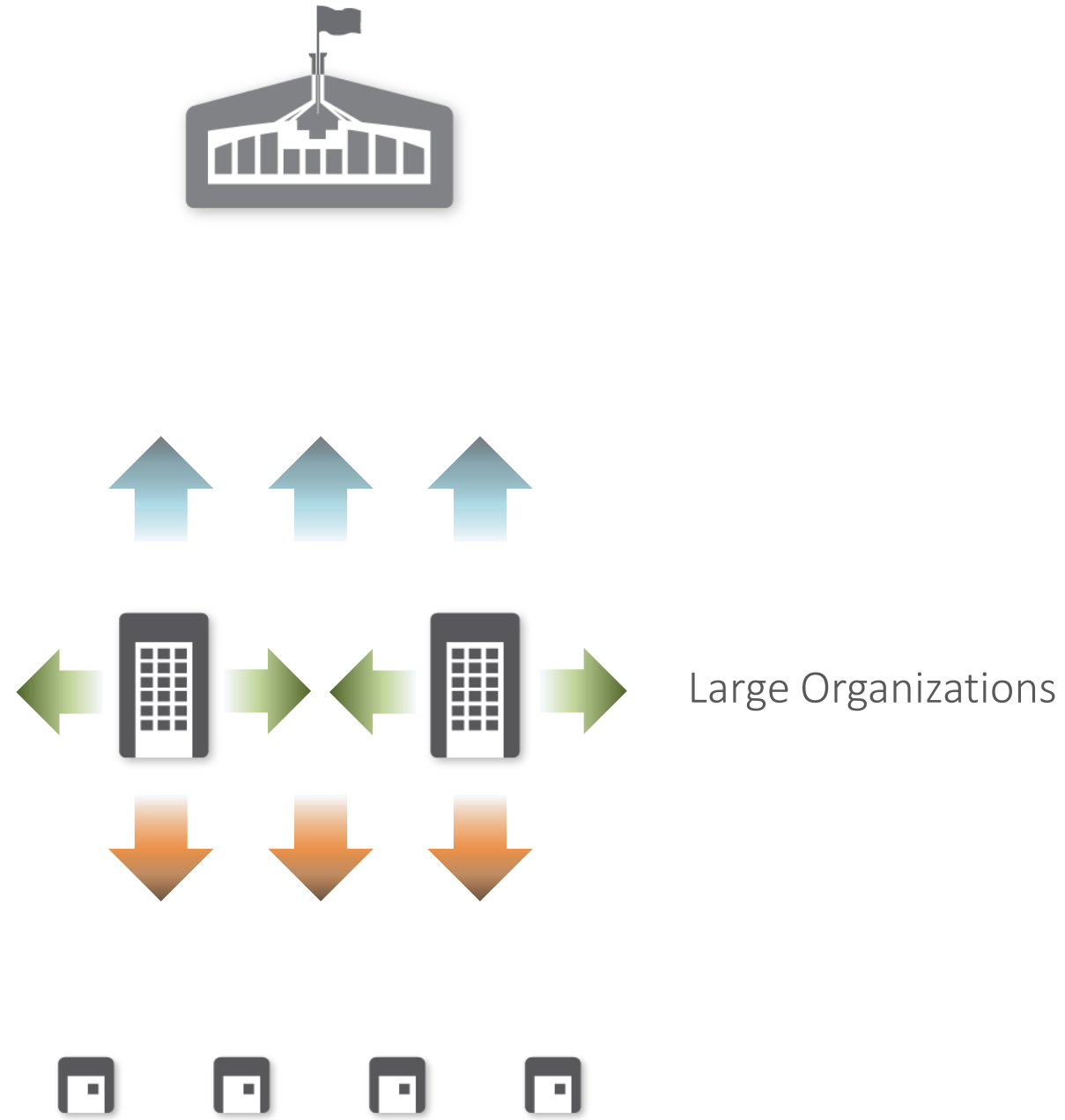


BOTTOM-up

Small Organizations

Diffusion Dynamics Model

clarifies the *how* BIM diffuses within and across markets



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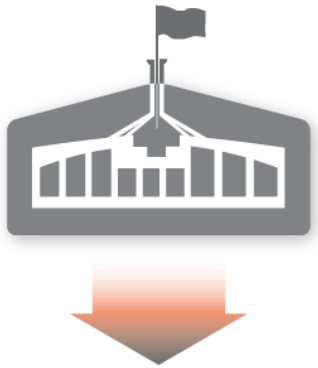


Government

Downwards Pressures

coercive pressures

Large Organizations

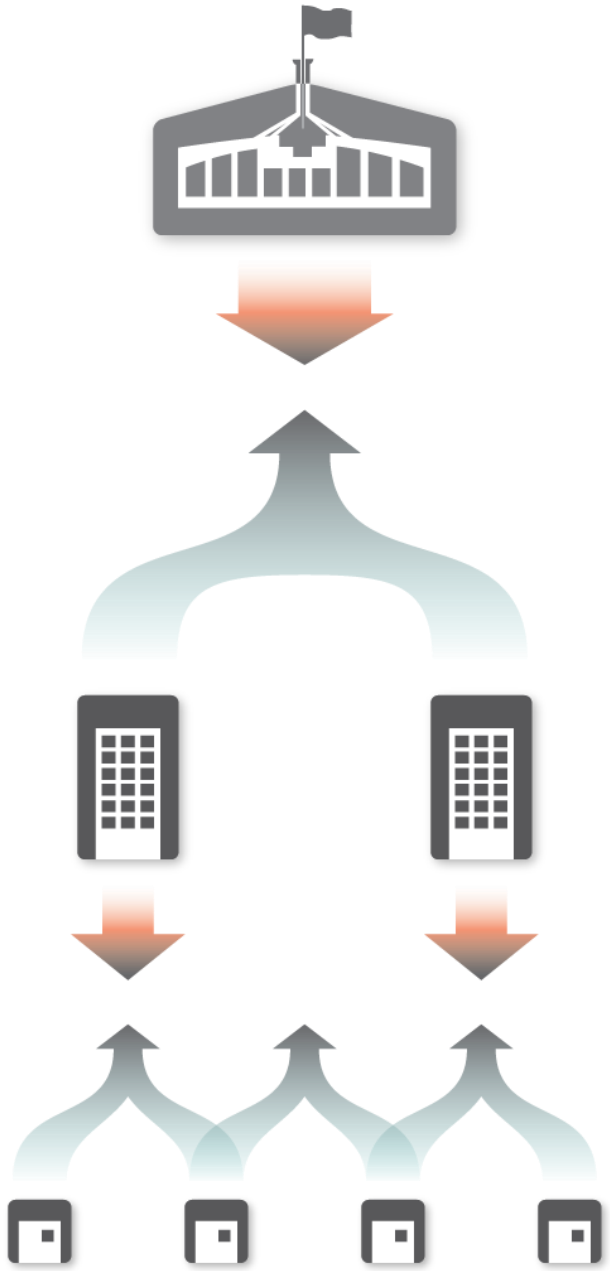
Downwards Pressures

coercive pressures

Small Organizations

Diffusion Dynamics Model

clarifies the *how* BIM diffuses within and across markets



Government

normative pressures

Upwards Pressures

Large Organizations

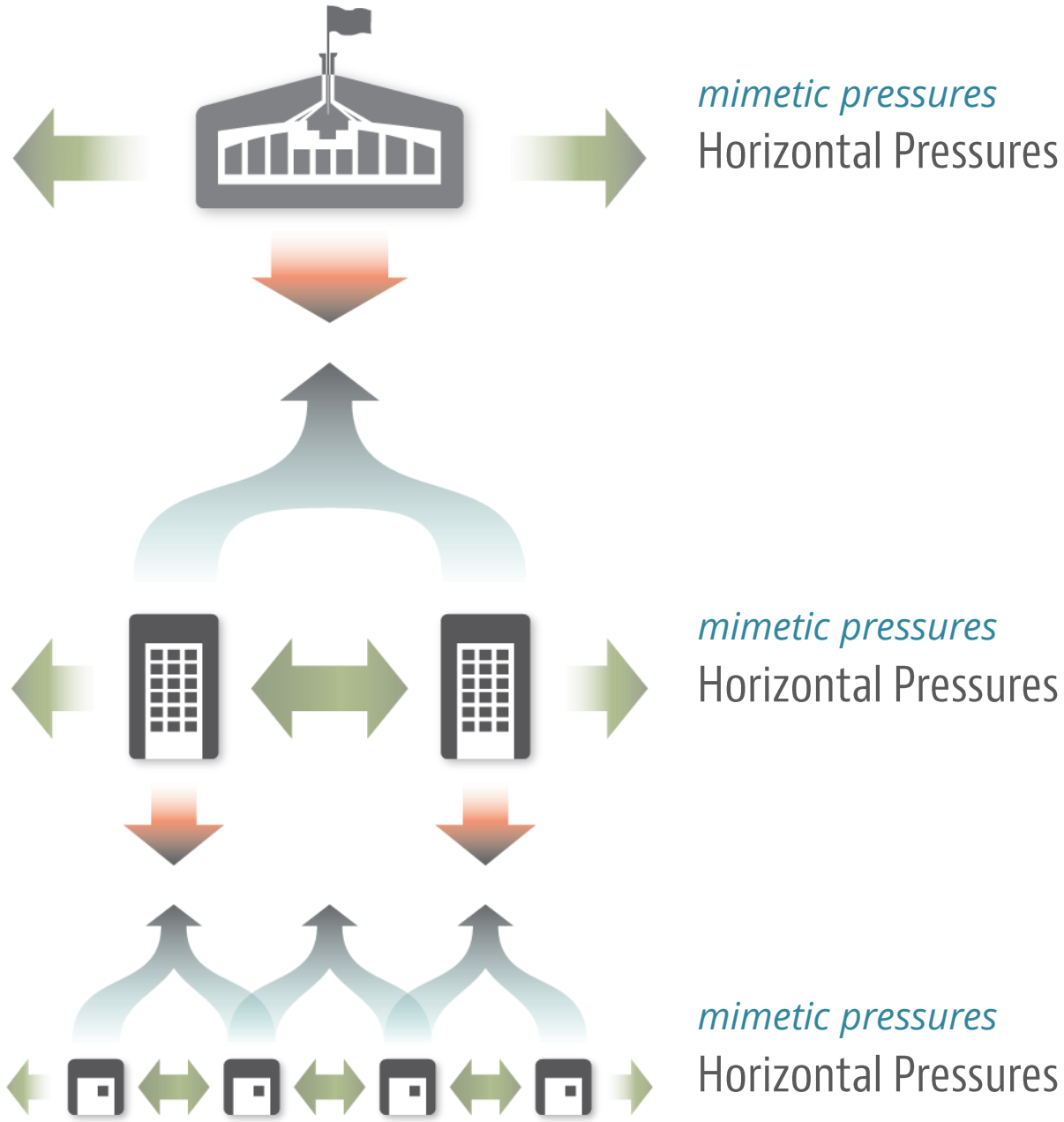
normative pressures

Upwards Pressures

Small Organizations

Diffusion Dynamics Model

clarifies the *how* BIM diffuses within and across markets



Macro-BIM adoption: Diffusion of Innovation within Markets and across Countries

	Top Down	Middle-out	Bottom-up
Australia		•	
Brazil		•	
Canada		•	
China		•	
Finland		•	
Hong Kong	•		
Ireland		•	
Italy		•	
Malaysia		•	
Mexico		•	
Netherlands		•	

	Top Down	Middle-out	Bottom-up
New Zealand			•
Portugal		•	
Qatar		•	
Russia		•	
South Korea		•	
Spain			•
Switzerland		•	
UAE	•		
UK	•		
USA		•	

Diffusion dynamics across the 2015 sample

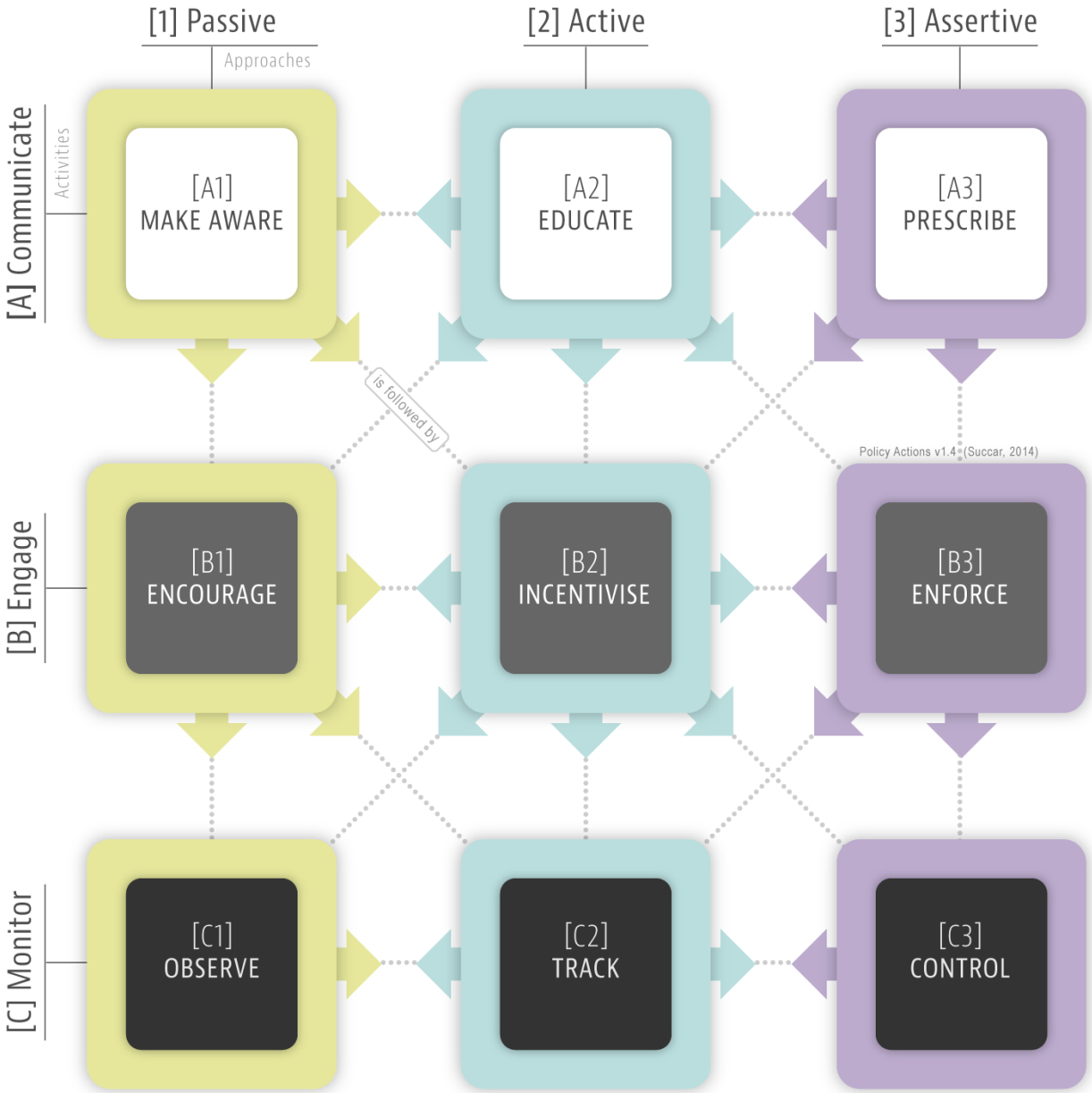
Macro-BIM adoption:
Diffusion of Innovation within Markets and across Countries

Policy Actions Model

Policy Actions Model

clarifies how different Policy Makers have *different Policy Approaches* to influencing BIM Adoption

The model includes
3 Policy Approaches:
Passive, Active, & Assertive; *and*
3 Policy Activities:
Make Aware, Encourage & Observe



Policy Approaches

Make Aware

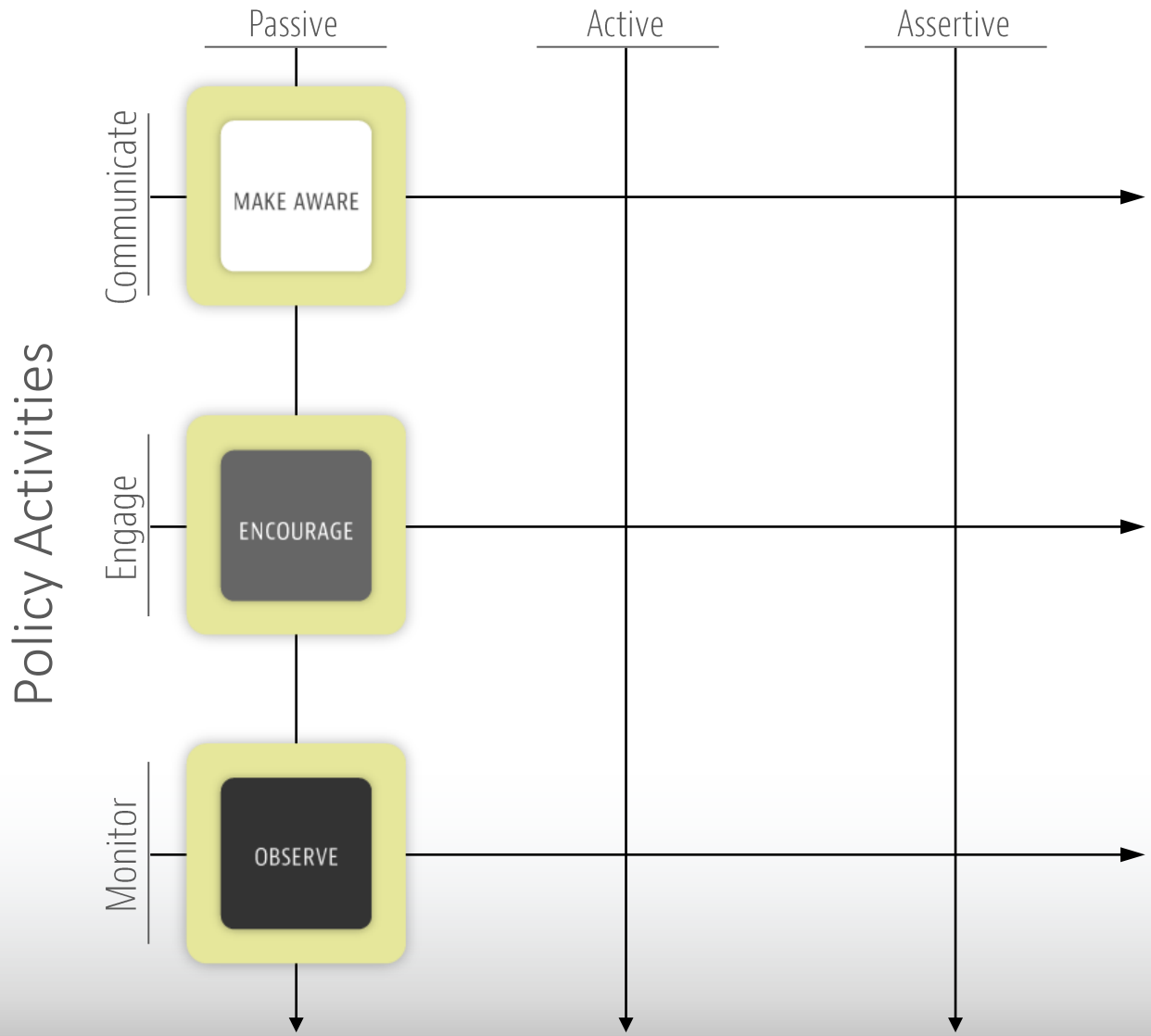
policy player informs stakeholders of the importance of a new system/process

Encourage

policy player conducts networking events to encourage stakeholders to adopt the system/ process

Observe

policy player observes if stakeholders adopt the system/process



Policy Approaches

Educate

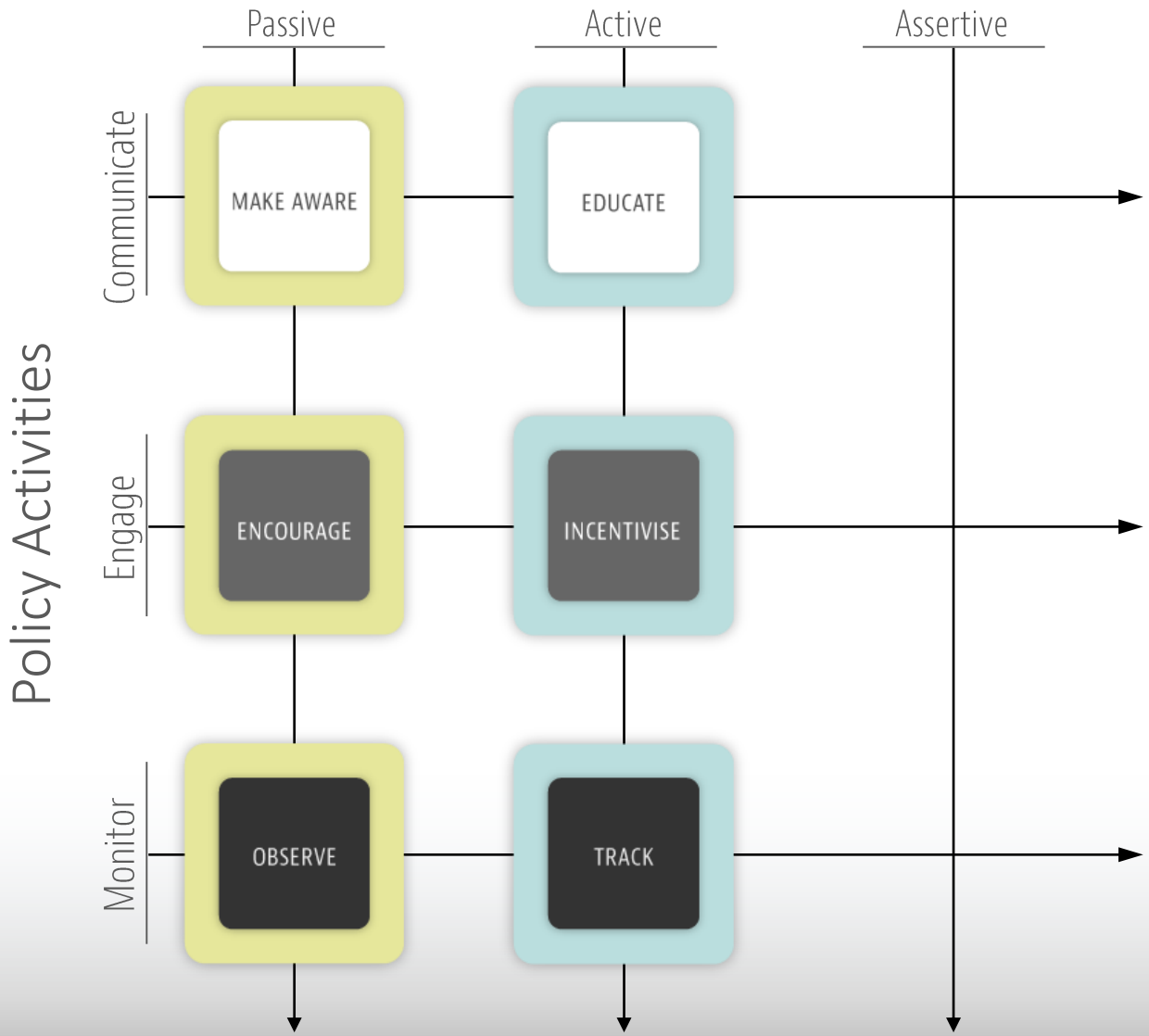
policy player generates informative guides to educate stakeholders of the system/process

Incentivise

policy player provides incentives and to stakeholders adopting the system/process

Track

policy player tracks how the system/process is adopted by stakeholders



Policy Approaches

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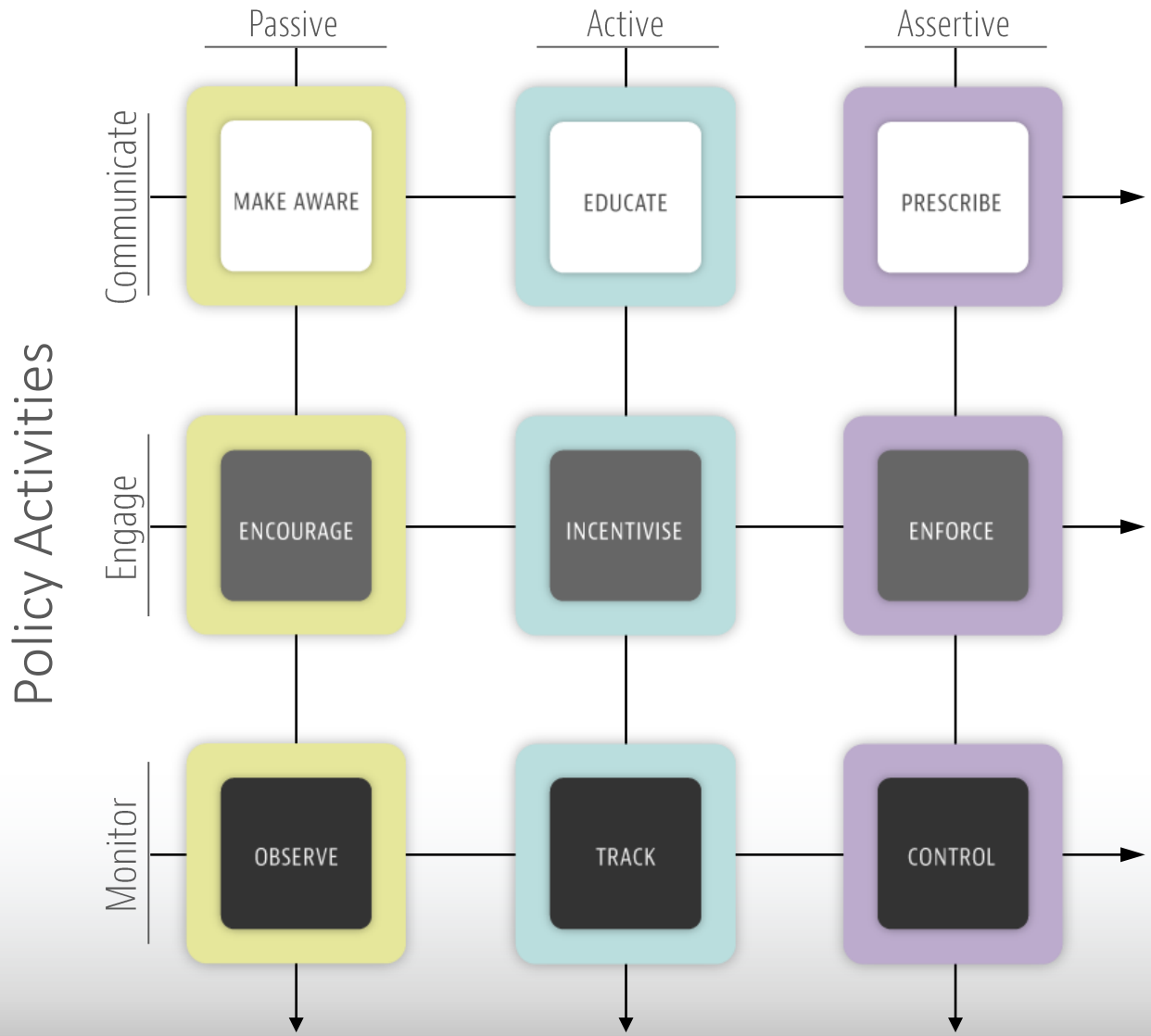


Prescribe
policy player details the exact system/ process to be adopted by stakeholders

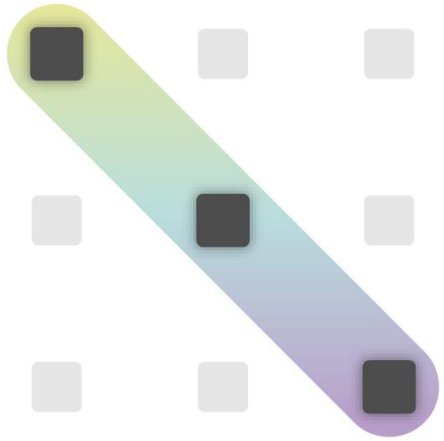
Enforce
Policy player favours or penalises stakeholders based on their adoption of the system/process

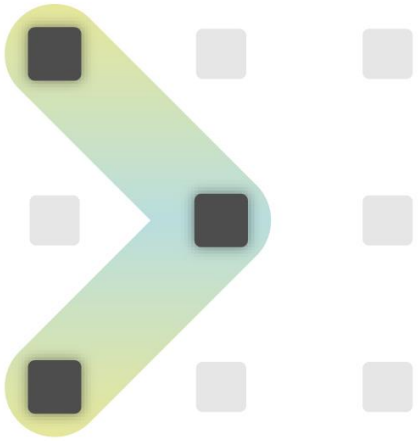
Control
policy player establishes compliance gates and mandatory standards for the prescribed system/process

Policy Actions Charts

comparative
sample charts

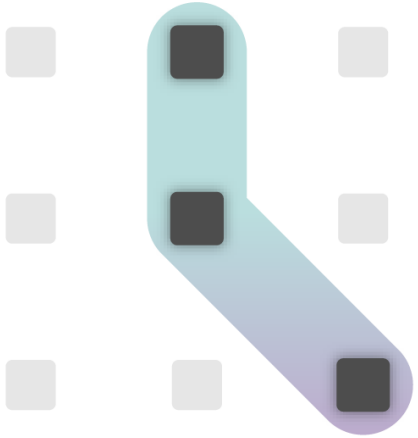
Make Aware
Incentivise
Control

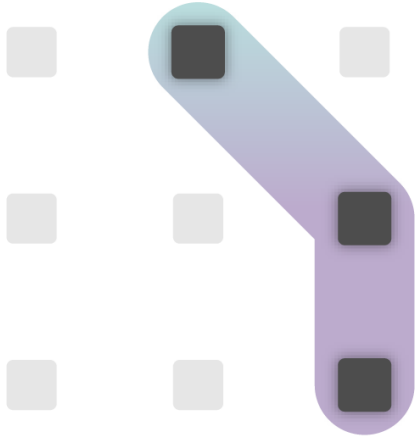




Make Aware
Incentivise
Observe

Educate
Incentivise
Control





Educate
Enforce
Control

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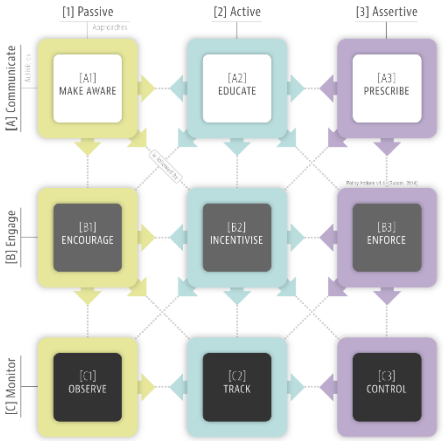


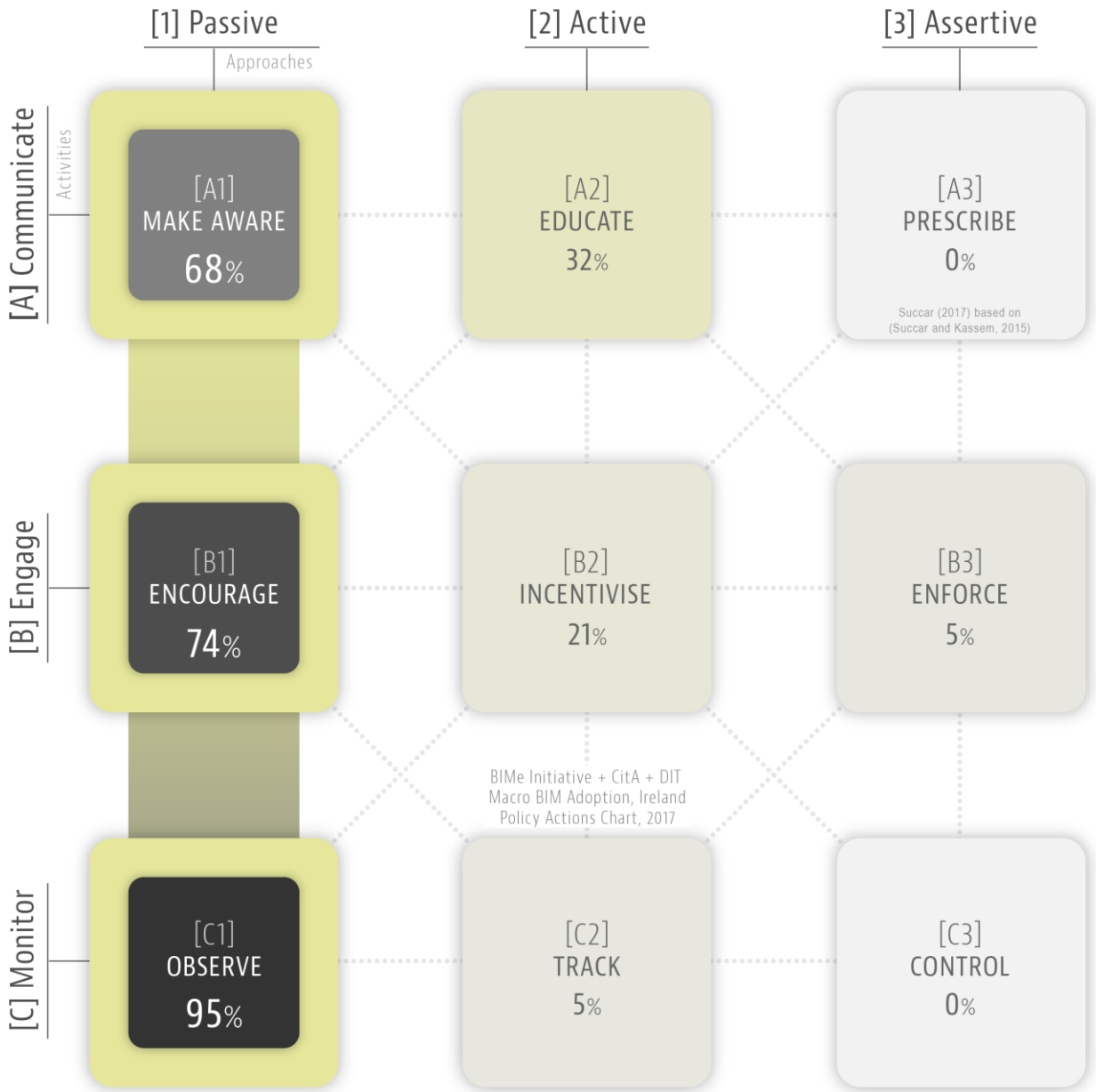
Policy Action types across the 2015 sample

	Communicate - Passive Make Aware	*Communicate - Active* Educate	*Communicate - Prescriptive* Prescribe	*Engage - Passive* Encourage	*Engage - Active* Incentivise	*Engage - Prescriptive* Enforce	*Monitor - Passive* Observe	*Monitor - Active* Track	*Monitor - Prescriptive* Control
Australia	•			•			•		
Brazil	•			•			•		
Canada	•			•			•		
China		•		•			•		
Finland		•		•			•		
Hong Kong		•		•			•		
Ireland	•			•			•		
Italy	•			•			•		
Malaysia	•			•			•		
Mexico	•			•			•		
Netherlands		•			•		•		
New Zealand	•			•			•		
Portugal	•			•			•		
Qatar	•			•			•		
Russia	•			•			•		
South Korea		•		•			•		
Spain	•			•			•		
Switzerland	•			•			•		
UAE	•			•			•		
UK		•				•		•	
USA		•		•			•		
Frequency	**14**	**7**	**0**	**20**	**1**	**1**	**20**	**1**	**0**

Policy Actions Chart

Ireland 2017

Macro BIM Adoption Snapshot
conducted in collaboration with CitA and DIT

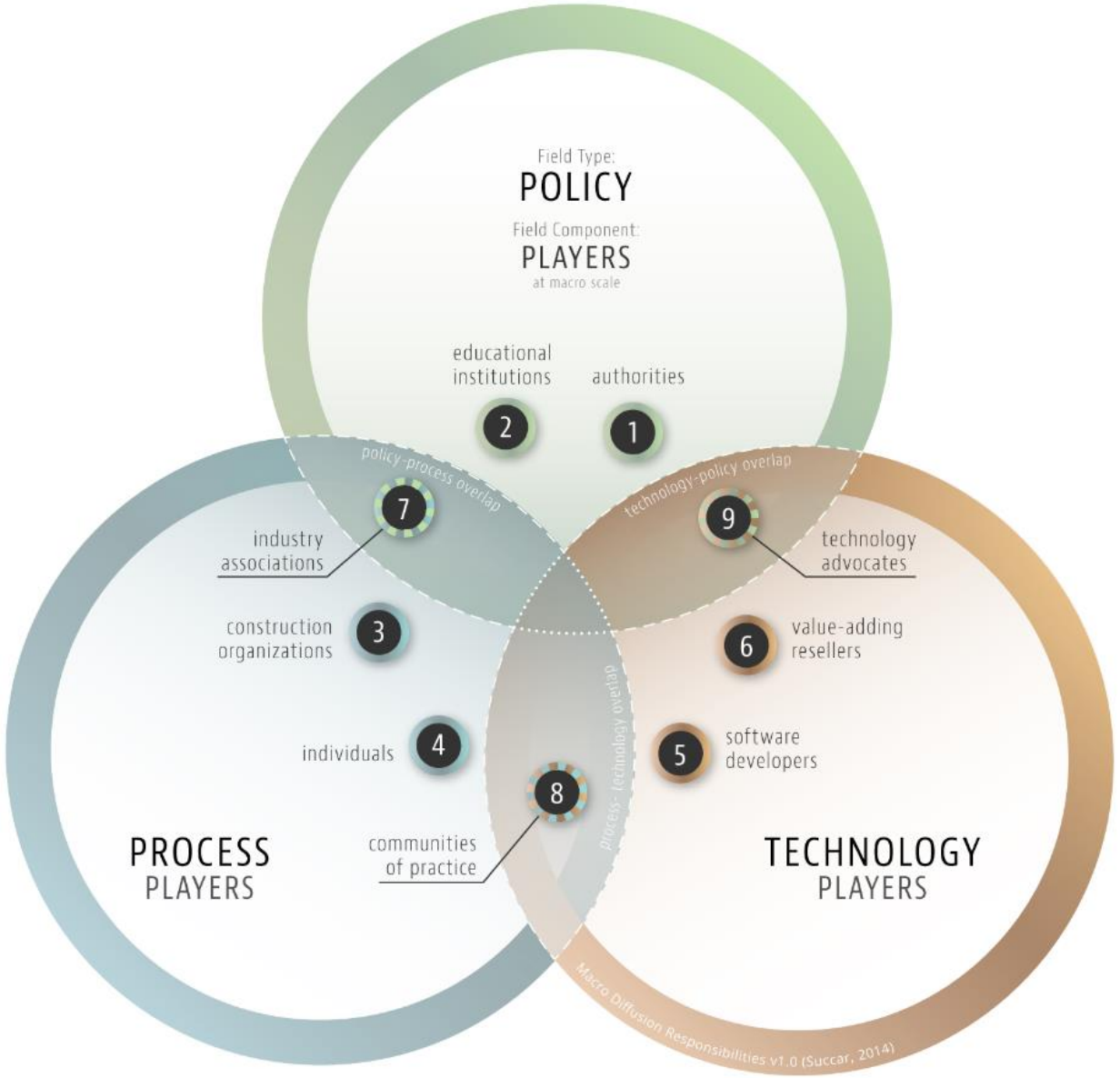


Macro-BIM adoption:
Diffusion of Innovation within Markets and across Countries

Diffusion Responsibilities Model

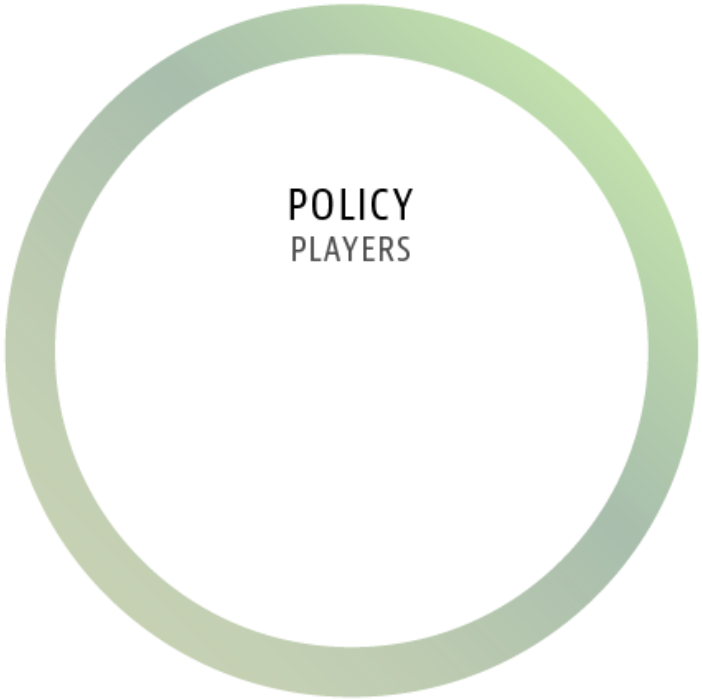
Diffusion Responsibilities Model

clarifies the *different BIM Diffusion Roles* played by industry stakeholders – clustered into 9 Groups



Diffusion Responsibilities Model

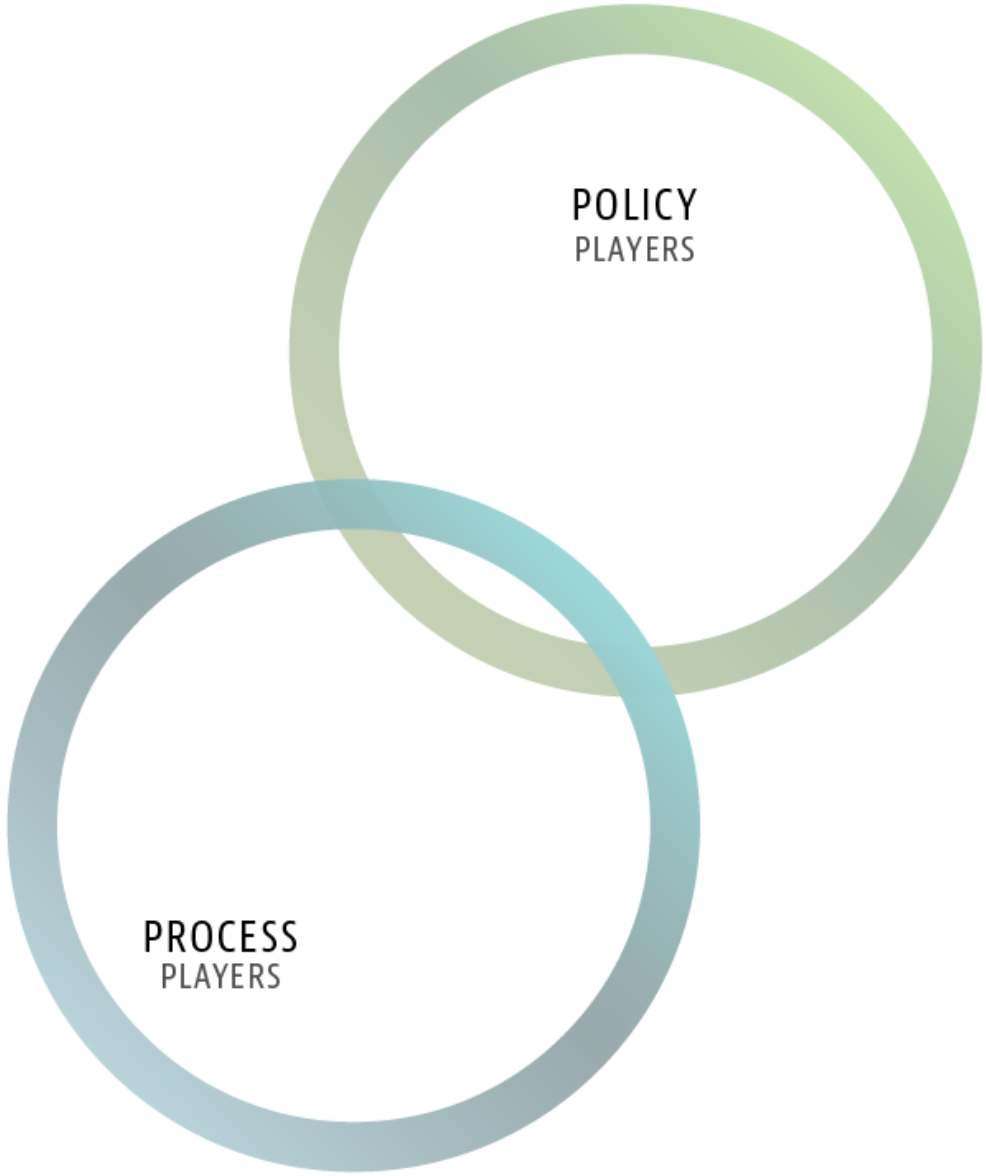
clarifies the *different BIM Diffusion Roles* played by industry stakeholders – clustered into 9 Groups



BIM Fields

Diffusion Responsibilities Model

clarifies the *different BIM Diffusion Roles* played by industry stakeholders – clustered into 9 Groups



BIM Fields

Diffusion Responsibilities Model

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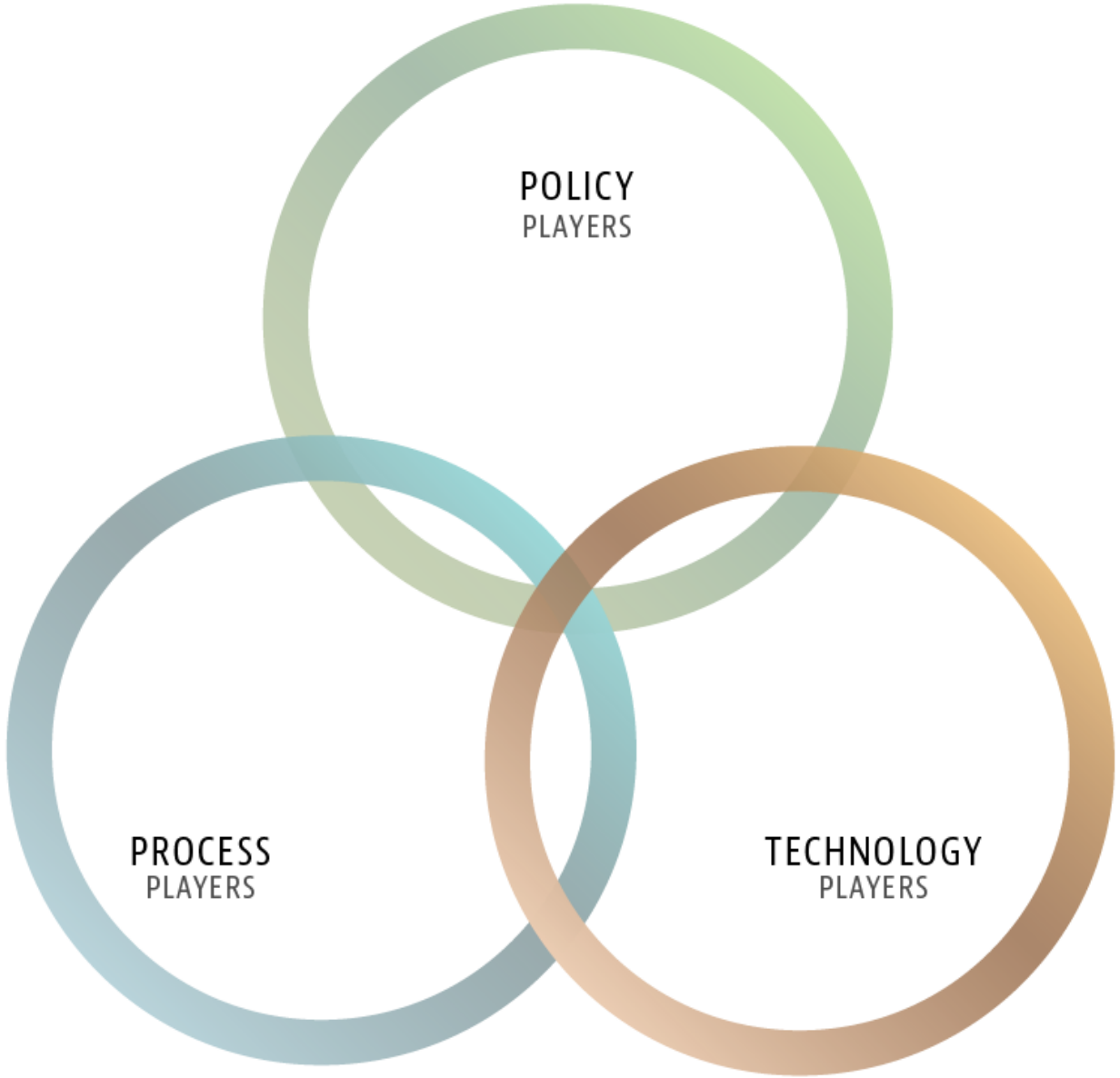

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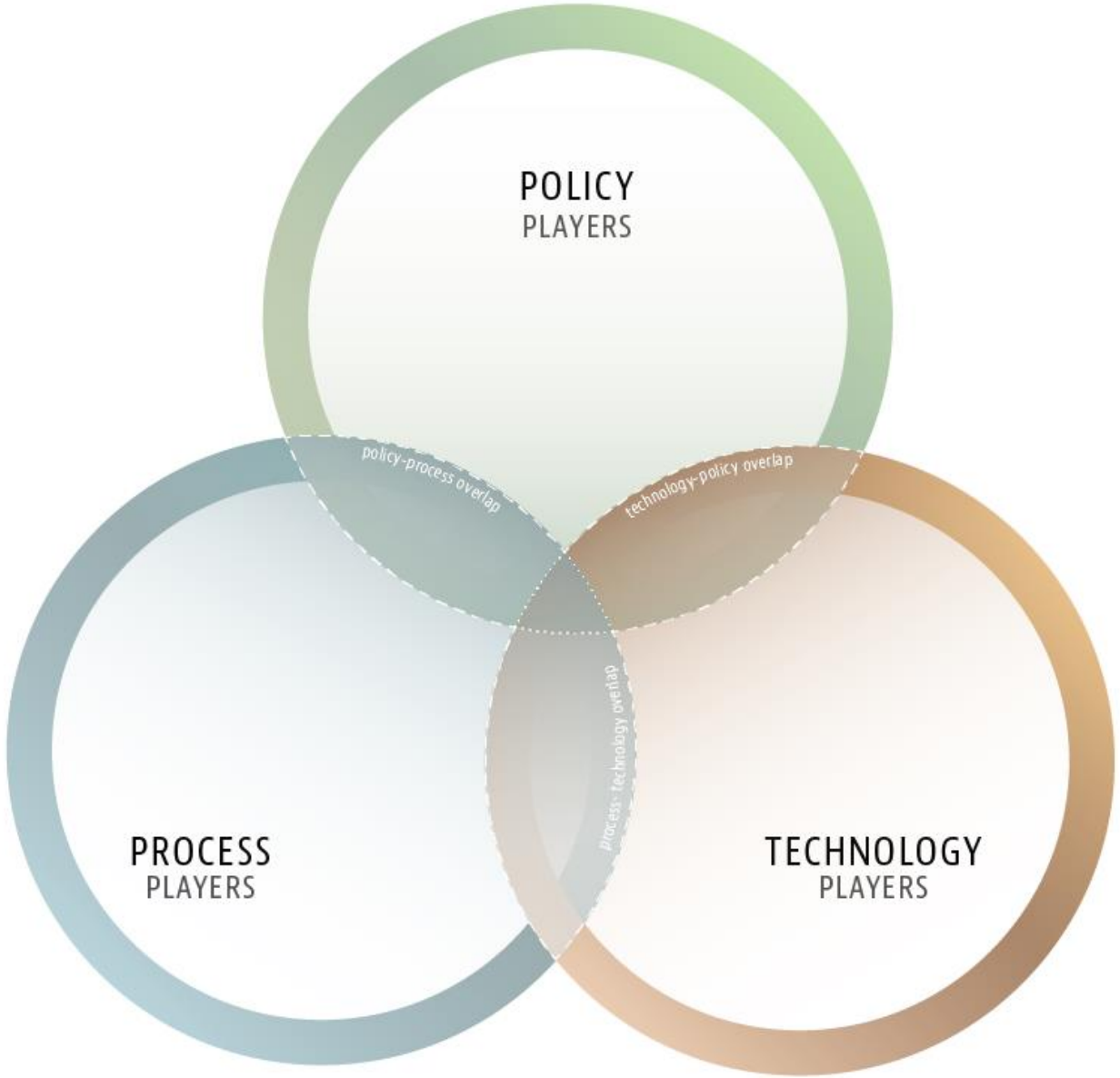
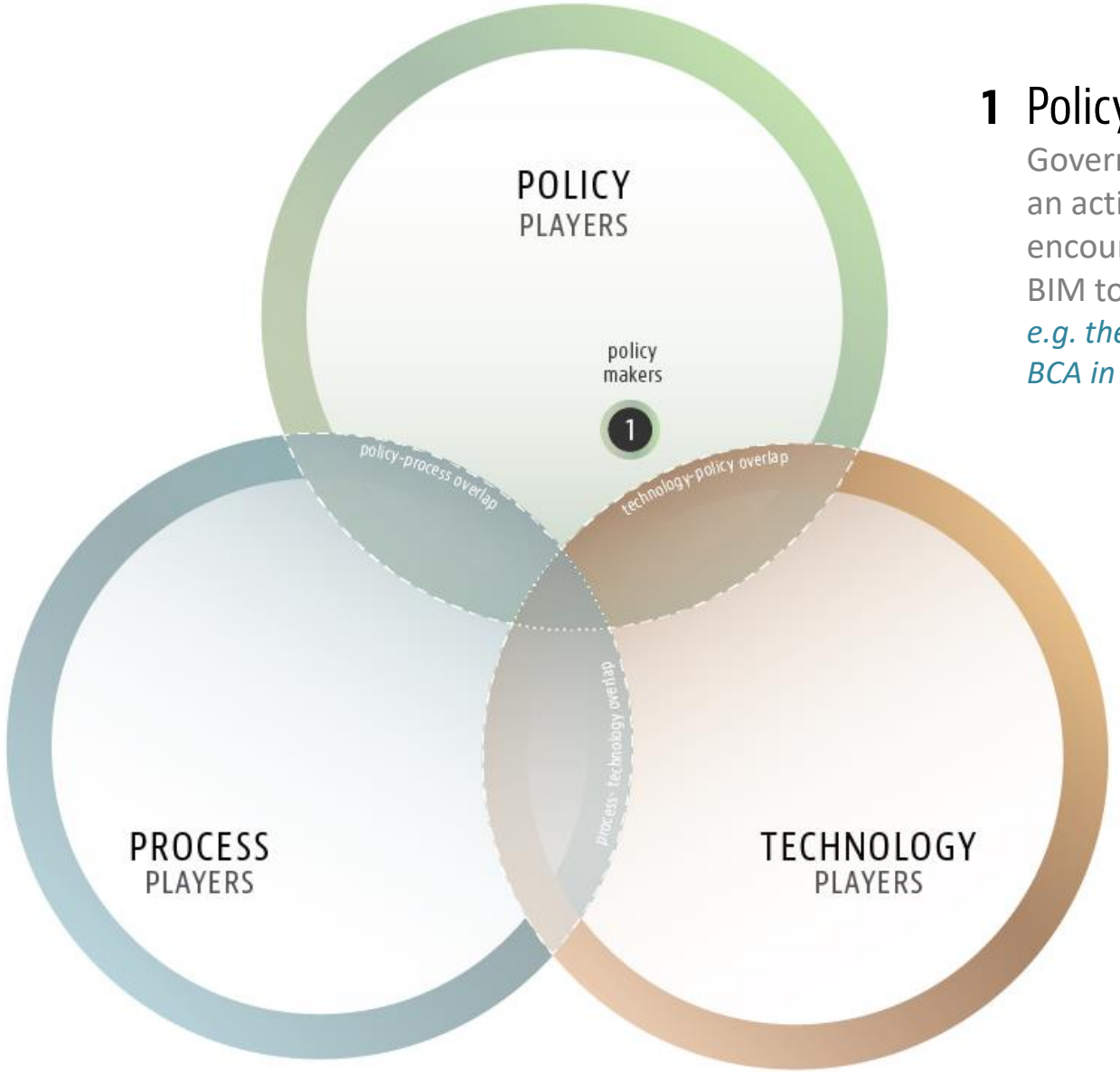


BIM Fields

Macro-BIM adoption: Diffusion of Innovation within Markets and across Countries



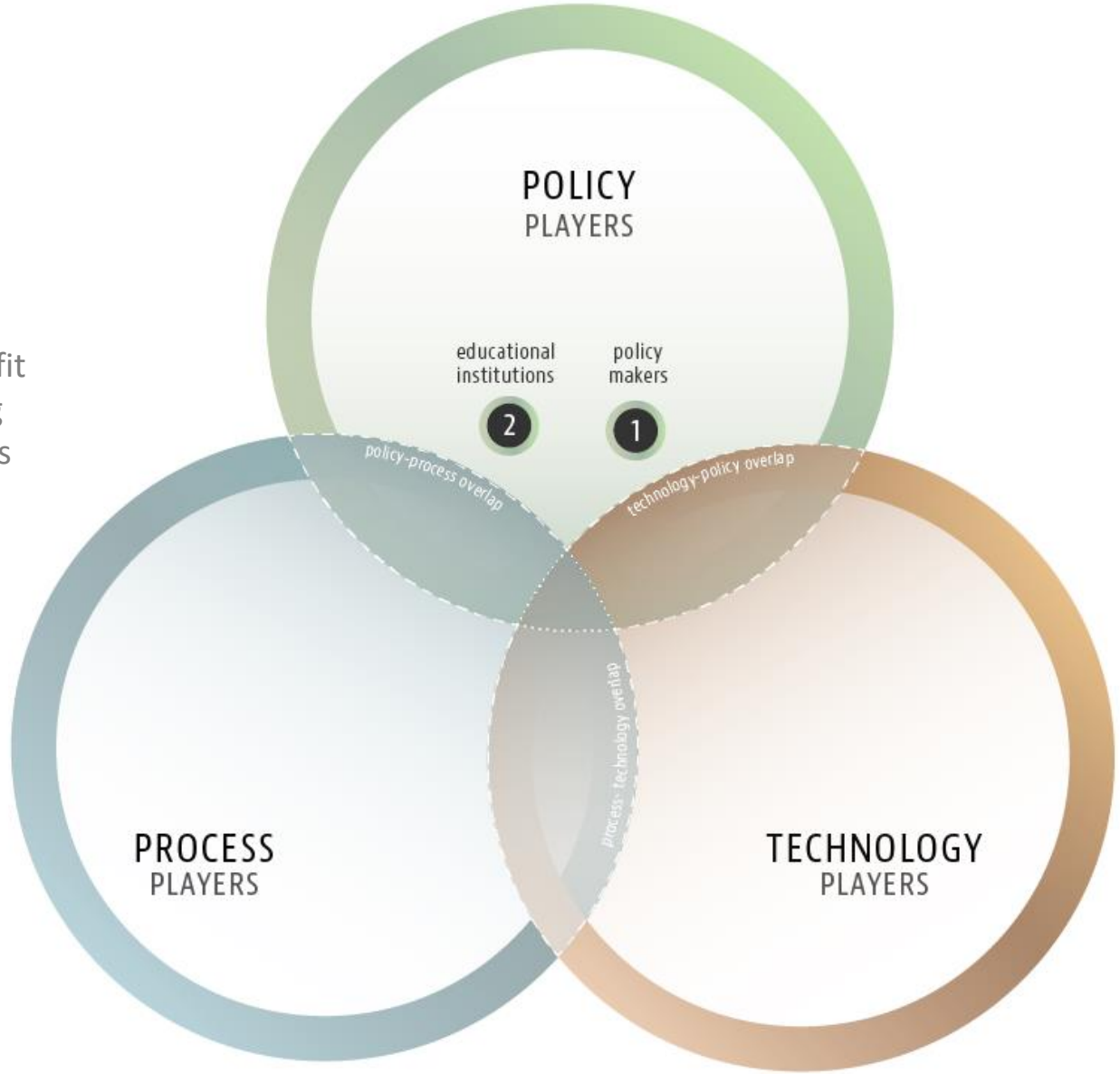
1 Policy Makers

Governmental players playing an active role in mandating or encouraging the adoption of BIM tools and workflows

e.g. the Task Group in the UK and BCA in Singapore

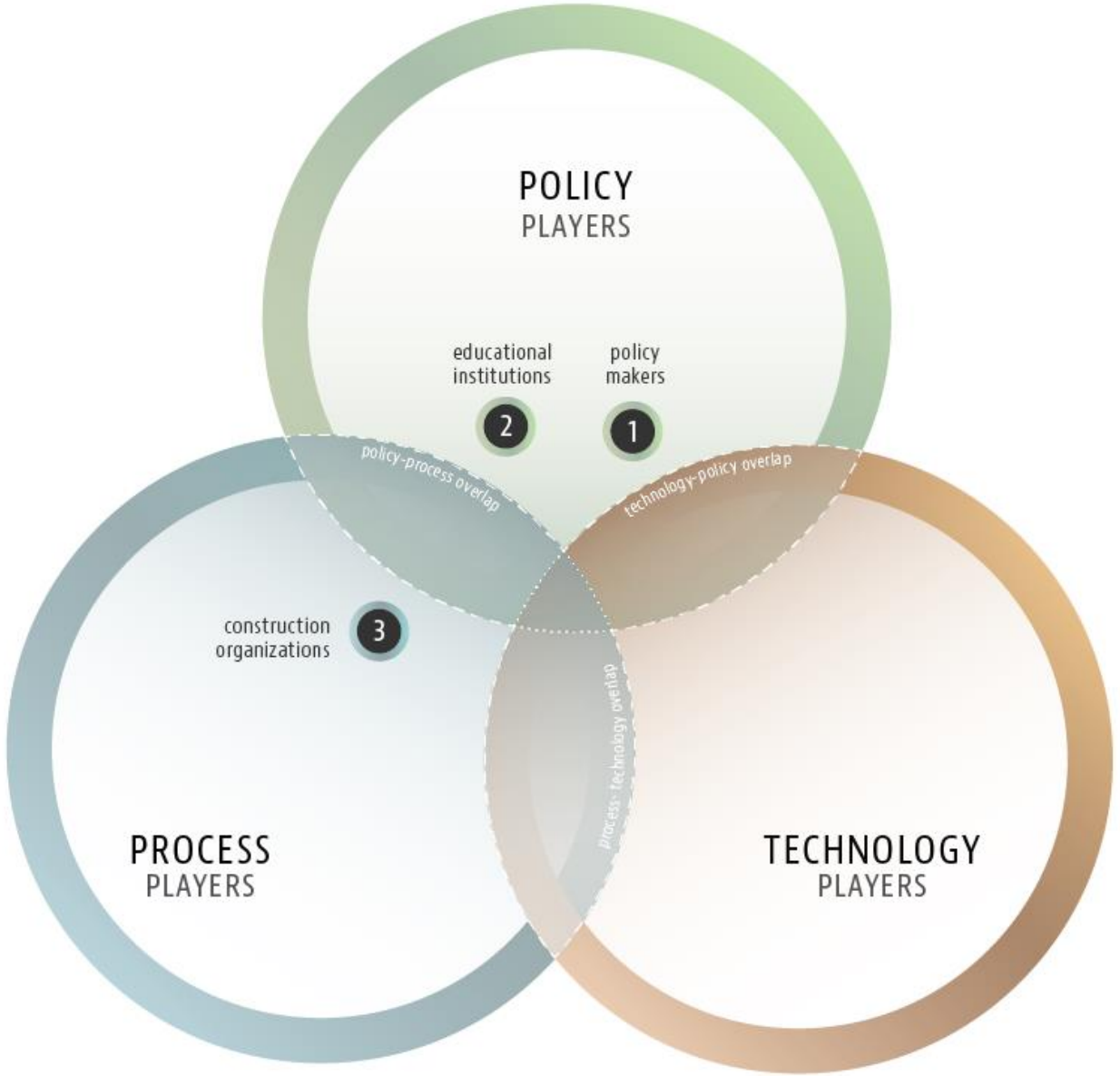
2 Educational Institutions

The universities and not-for-profit technical institutions developing and delivering learning programs and materials



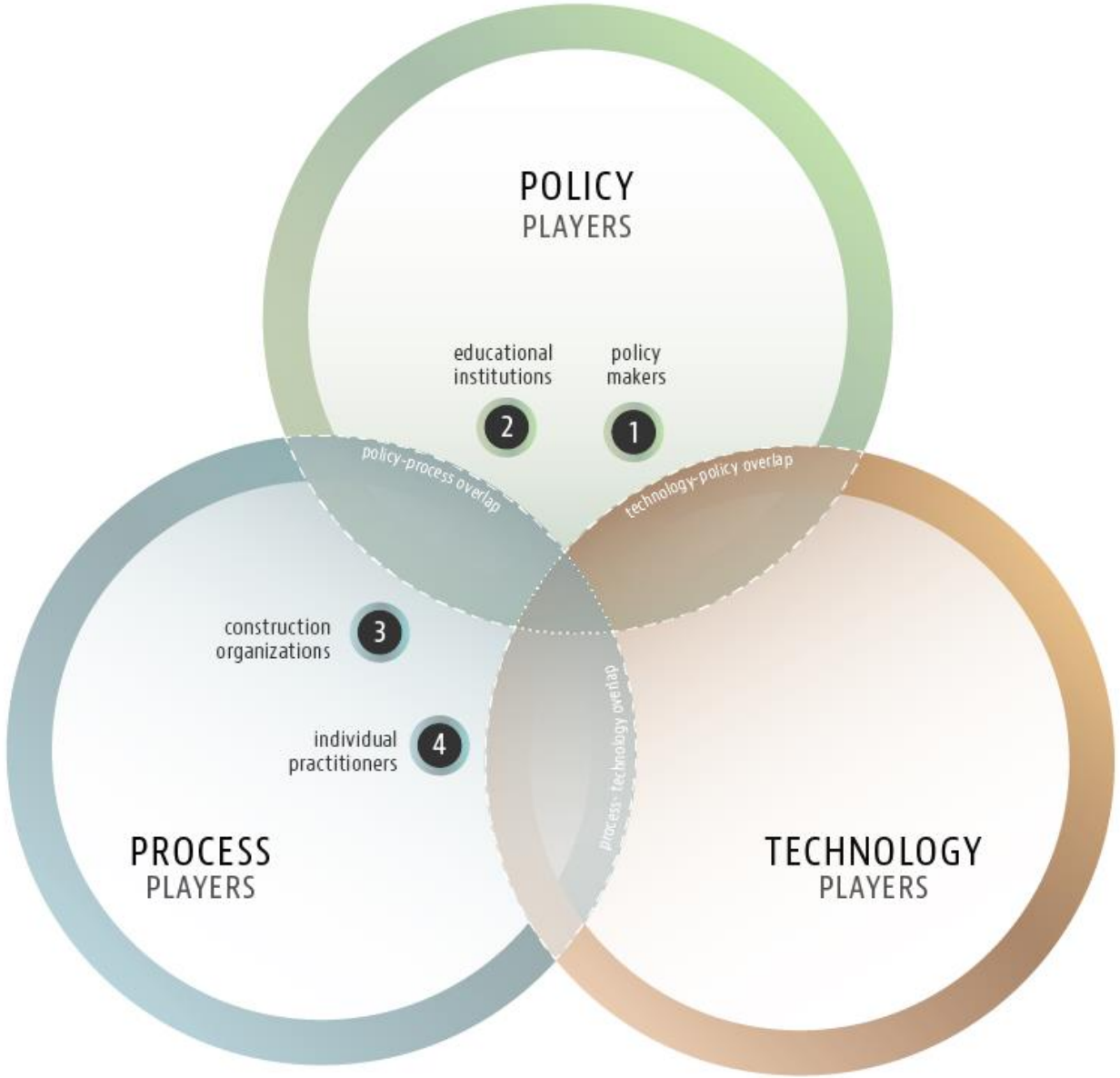
3 Construction Organizations

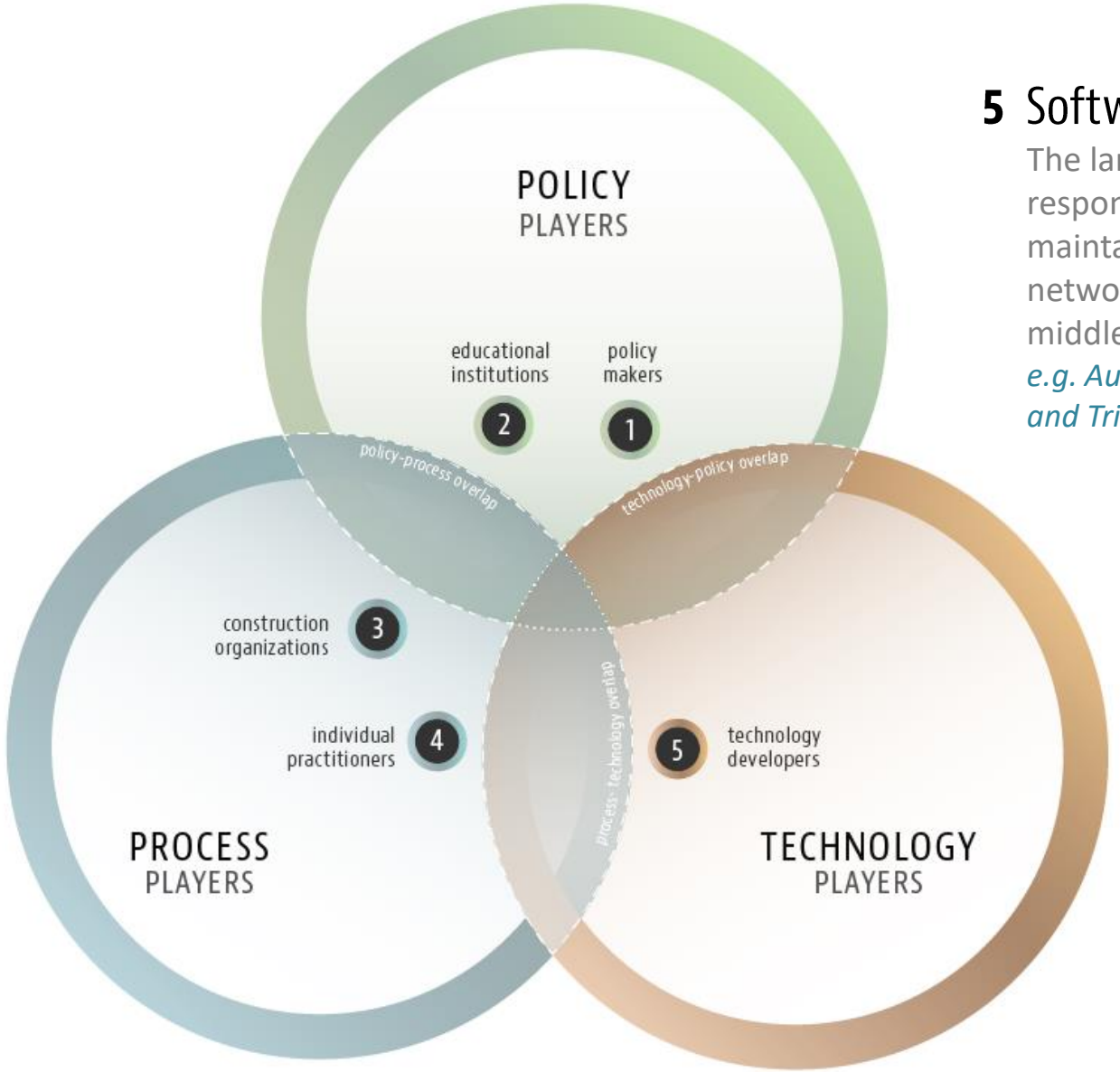
Designers, contractors, owners, operators and other organizational players involved in deploying BIM tools and workflows, training their staff and delivering BIM-enabled outcomes



4 Individuals

The individual practitioner, researcher, lecturer and student involved in learning, or actively implementing BIM tools and workflows





5 Software Developers

The large software houses responsible for developing and maintaining BIM software tools, network solutions and middleware

e.g. Autodesk, Nemetschek and Trimble

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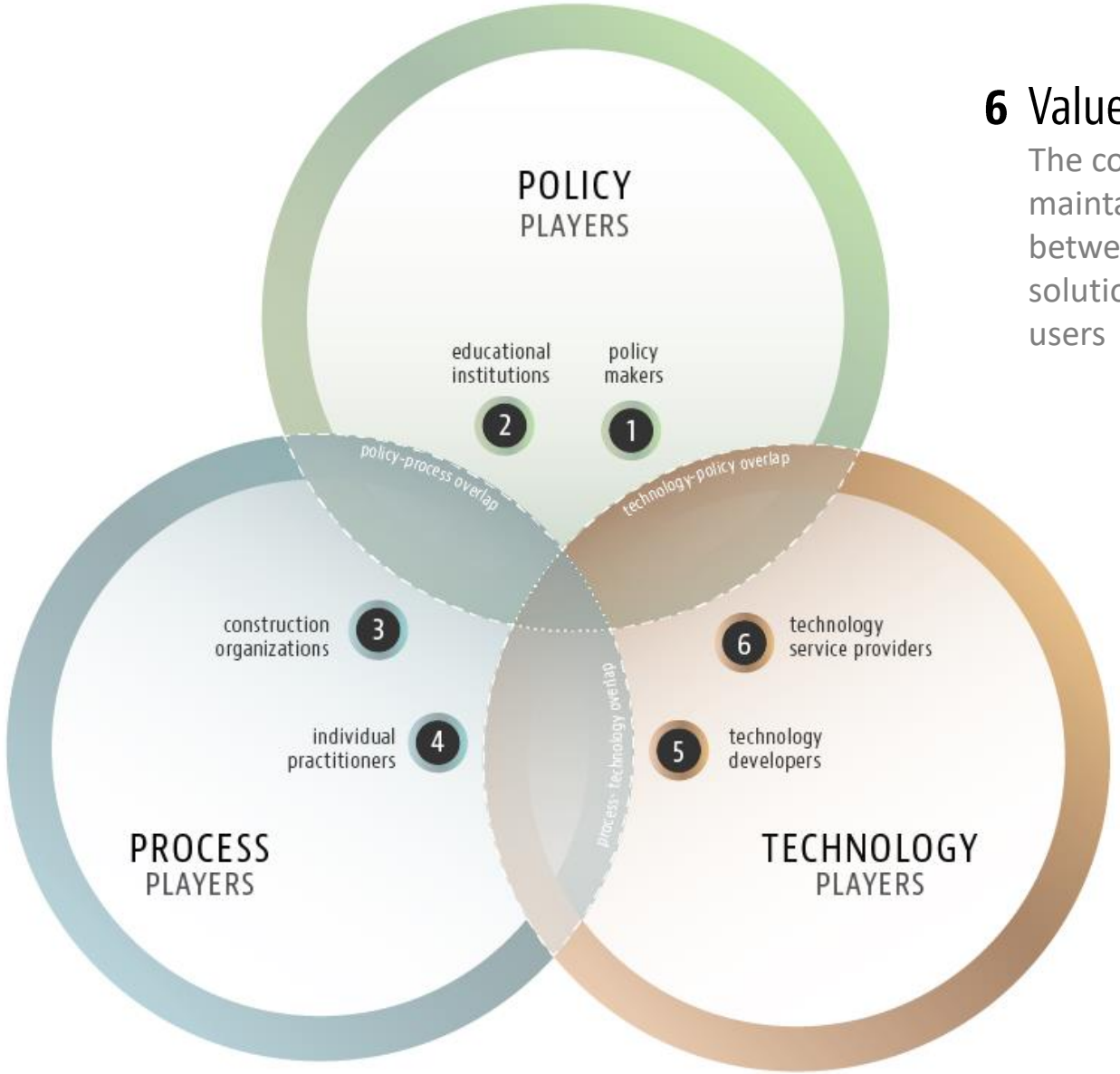


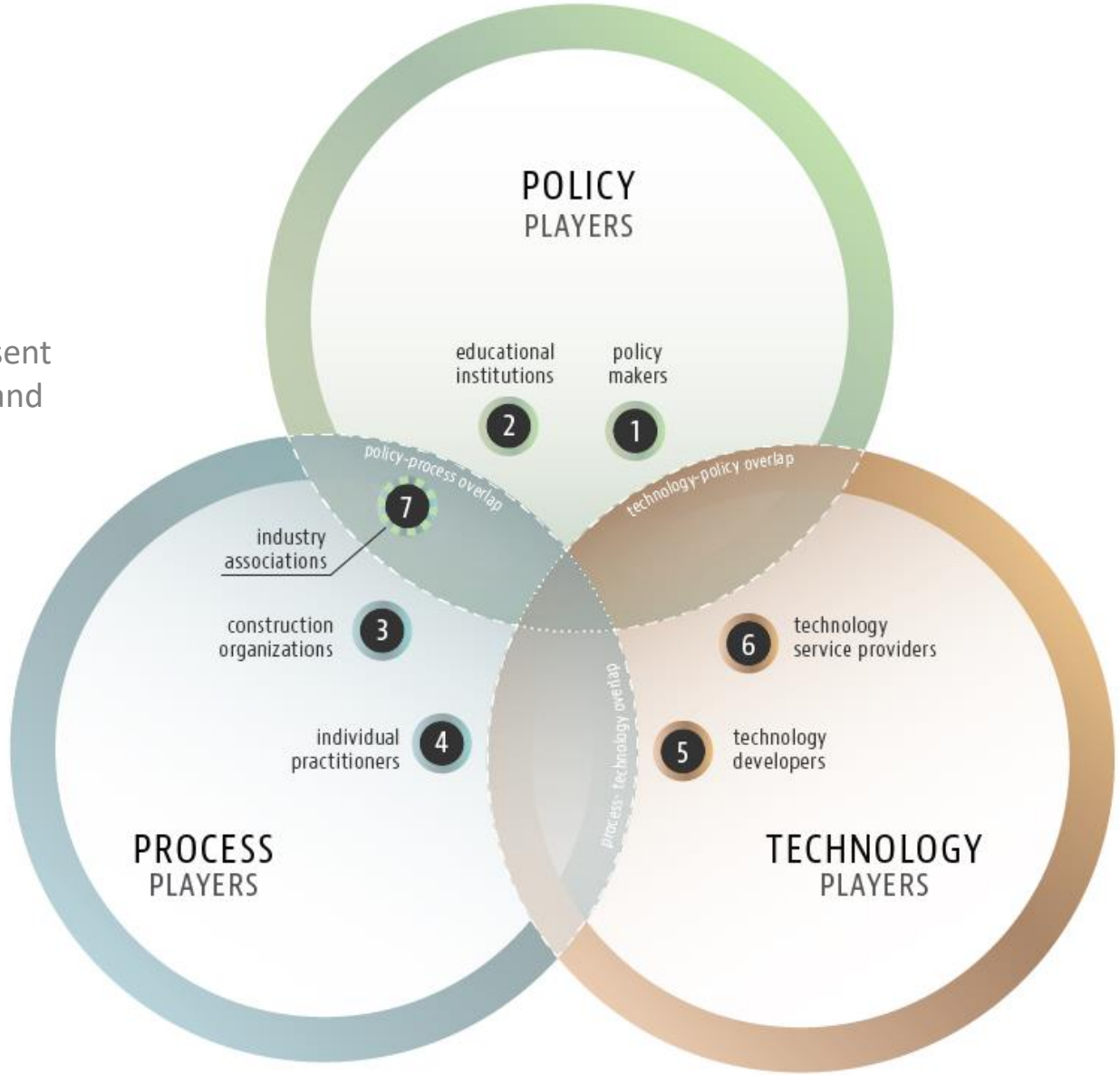
6 Value-adding Resellers

The companies bridging and maintaining the relationship between software/network solution developers and end users

7 Industry Associations

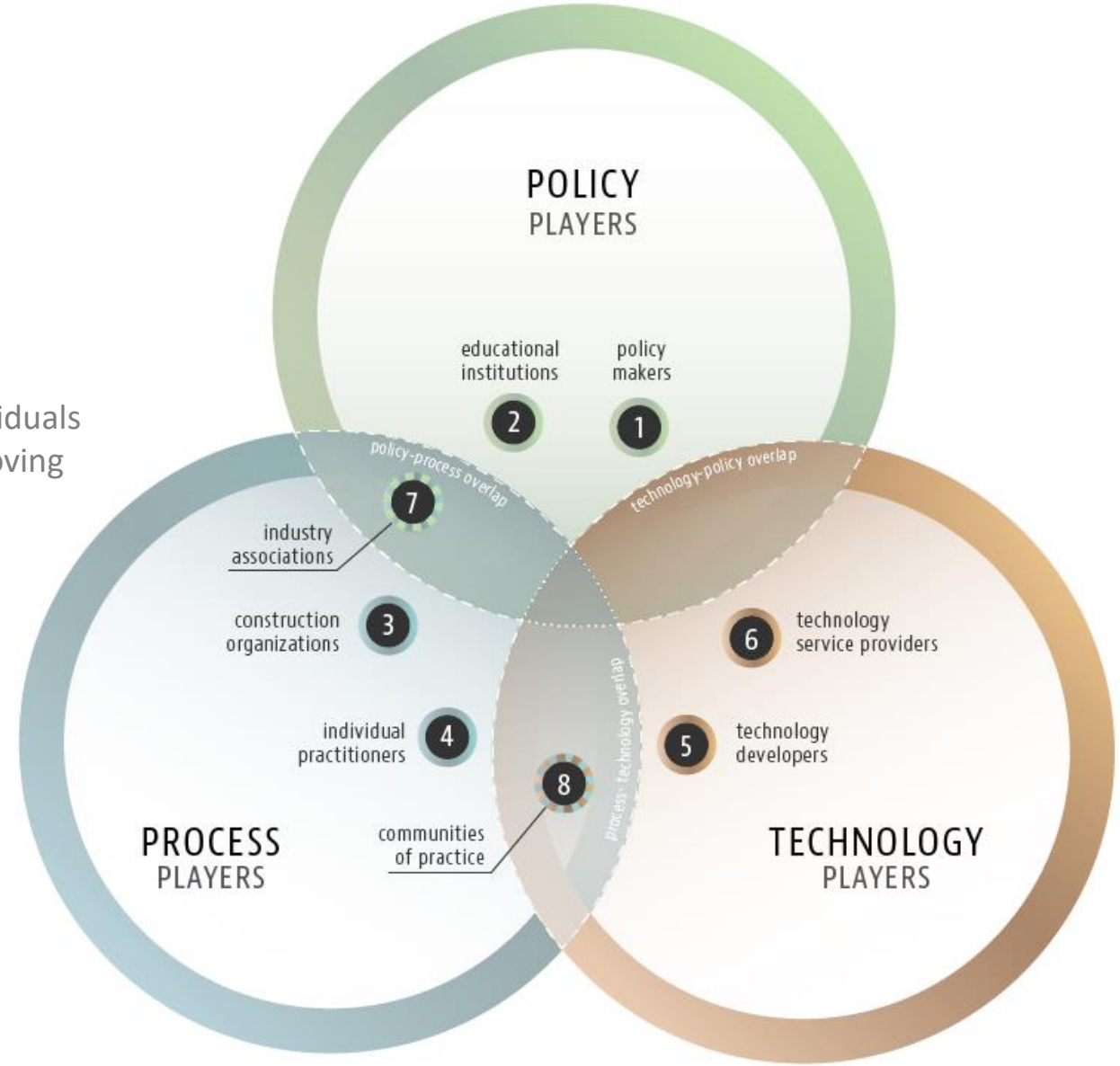
Associations dedicated to represent the interests of their individual and organizational members

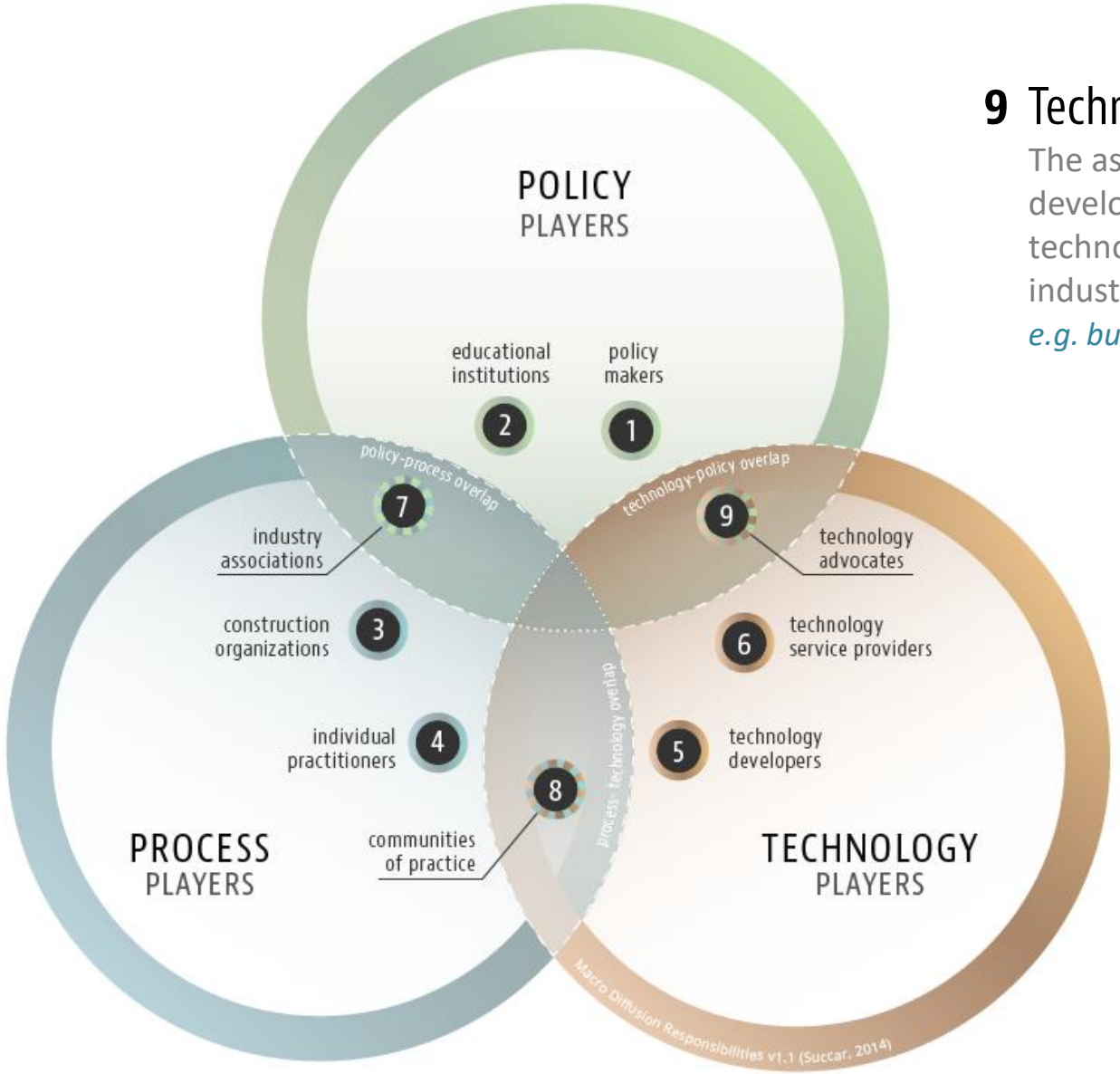
e.g. AMCA in Australia



8 Communities of Practice

The informal grouping of individuals with a shared interest in improving their own BIM performance
e.g. Revit user groups





9 Technology Advocates

The associations involved in developing and promoting technology-centric solutions for industry problems

e.g. buildingSMART

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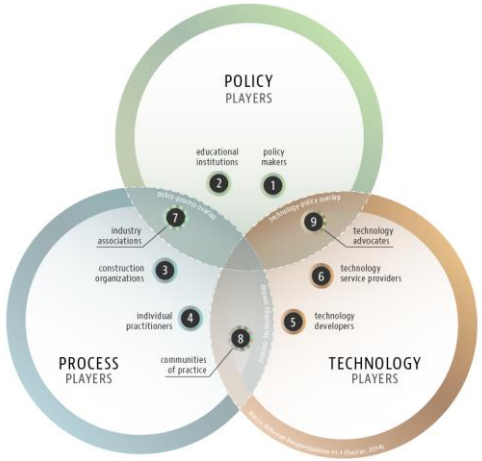


contributions by Player Type across the 2015 sample

	Policy Makers	Educational Institutions	Construction Organisations	Technology Developers	Technology Service Providers	Industry Associations	Communities of Practice	Technology Advocates
Australia	25	25	50	88	75	63	63	88
Canada	8	18	43	75	75	18	68	68
China	68	58	83	93	83	58	50	58
Finland	20	25	70	75	75	50	95	100
Hong Kong	68	50	50	93	75	50	68	68
Malaysia	43	33	33	75	75	25	50	58
New Zealand	13	50	13	63	75	0	25	63
Brazil	45	38	45	83	70	50	38	58
Ireland	8	83	68	100	83	83	75	68
Italy	0	58	25	45	45	33	38	33
Mexico	25	68	75	93	83	75	68	83
Netherlands	83	83	75	93	93	83	93	83
Portugal	0	45	25	58	55	43	58	33
Qatar	20	45	63	58	50	50	68	63
Russia	25	13	25	100	88	50	13	13
Spain	40	43	33	60	53	50	53	48
Switzerland	0	75	50	50	50	50	50	75
UAE	50	25	58	93	83	50	75	83
UK	85	58	63	83	73	58	55	70
USA	25	50	85	95	80	65	75	70
South Korea	33	68	50	58	83	58	50	75

None
Low
Medium
High
Very High

BIM
EXPO
HANNOVER

Summary of findings + future research

Macro-BIM adoption:
Diffusion of Innovation within Markets and across Countries

Summary of Findings

The ongoing research has provided many insights into BIM Adoption patterns across markets - and even within the same market:

- The data collected showed many differences and similarities in diffusion types/rates, market maturity, actions taken by policy makers, diffusion dynamics and roles played by stakeholders;

- While certain diffusion patterns were expected (e.g. imitation of policies across national borders), other patterns were not (e.g. the prevalence of the middle-out diffusion dynamic); and

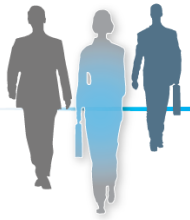
- To confirm these findings and to develop a clearer macro adoption picture, more in-depth analysis is needed as well as the repetition/comparison of assessments over regular periods.

Macro-BIM adoption:
Diffusion of Innovation within Markets and across Countries

Future Research

The Macro BIM Adoption research is now a *dedicated project* within the not-for-profit BIMe Initiative (BIMexcellence.org). The next planned steps are:

- Expand the data collection to cover new countries and regions;
- Develop a dedicated online dashboard to openly share raw macro adoption data and comparative results; and
- Develop new models, templates and tools to assist policy makers in measuring or improving their macro BIM adoption policies.



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