Impact of Smart Technologies on Construction Projects:
Improvements in Project Performance

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Contents

- Introduction
- Background
- Research approach
- Data presentation
- Data analysis and discussion
- Conclusion
- Q&A

Introduction

Smart Technologies

- Key technologies associated with 4IR include Cyber-Physical System (CPS), Internet-of-Things (IoT), Big Data (BD), Additive Manufacturing (AM), Augmented Reality (AR), Virtual Reality (VR), robotics, Autonomous Vehicles (AV), laser scanning and blockchain

- Can self-organise and self-execute work tasks

- Enable the integration, digitalisation, and automation of entire value chains

Research Motivation

- Potential to improve performance of industries

- Lack of awareness of the benefits increases the perceived risk of technology adoption, resulting in resistance towards adoption

Research Objectives

This study aims to investigate:

i.   the smart technologies perceived to be most useful in construction projects;

ii.   the improvements in the performance of construction projects that can be achieved from the implementation of smart technologies; and

iii.   the correlations among the smart technologies and the perceived improvements to project performances

Research Significance

- Better understanding of feasibility of adopting smart technologies and improvements in project performance

- Serve as foundation to develop a data-driven roadmap to drive the adoption of smart technologies in the construction industry

Background

Applications in Construction Projects

Real-time monitoring and control on site and along the supply chain

Integrated data platform for decision-making and optimised planning

Real-time communication

Research Approach

Research Approach

Literature review
- Establish foundation for the study and development of the survey questionnaire

Expert panel discussion and interviews
- Validate the survey questionnaire prior to distribution

Distribution of survey questionnaire
- Administered to 600 target respondents
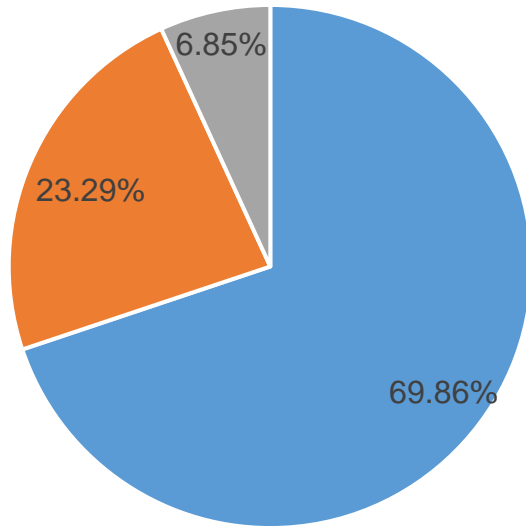- 73 valid responses received

Data analysis and post-survey interviews
- Analyse collected data
- Validate the findings from the survey questionnaire
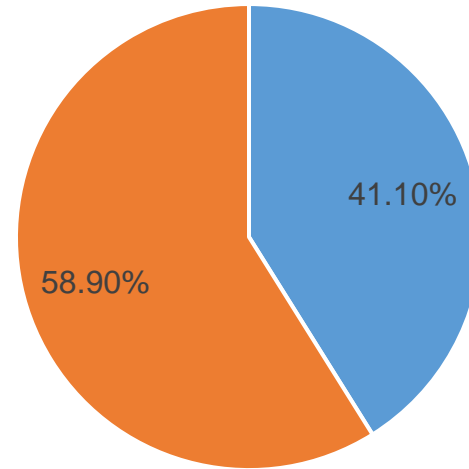
Data presentation

Profile of Respondents

Respondent Role

6.85%
23.29%
69.86%

■ Project managers ■ Architect ■ Director

Years of Experience in the Industry

41.10%
58.90%

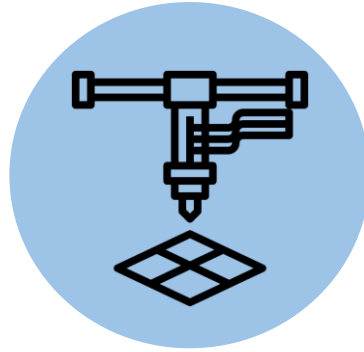■ Ten years and below ■ More than ten years

Data analysis and discussion

Top Smart Technologies that Improve Construction Projects Performance

- Autonomous vehicles and robotics
  - Automate dangerous and routine works
  - Improve productivity and quality
  - Increased consistency of works

- Additive manufacturing
  - Typically conducted off-site in controlled environment
  - Improves productivity and quality

Productivity = output/ on-site manpower

- Cyber-physical system and Internet-of-Things
  - Improve collaboration among stakeholders

15

Top Improvements in Construction Projects

- Improved productivity

- Improved quality

- Improved collaboration

16

Rank of Benefits of Smart Technologies in Construction Projects

	AV and robotics		AM		CPS and IoT		Big data		Laser scanning		AR and VR		Blockchain		Overall
	RT	RB	RT	RB	RT	RB	RT	RB	RT	RB	RT	RB	RT	RB	
Improve productivity	1	4	1	2	1	1	1	4	1	2	1	6	1	7	1
Improve quality	2	2	2	1	3	5	3	6	2	3	2	4	3	7	2
Improve collaboration	7	6	7	7	2	1	2	2	3	4	3	5	2	3	3
Cost saving	3	1	5	4	4	2	4	3	5	5	5	7	4	5	4
Time saving	4	1	3	2	5	2	5	5	4	4	6	6	5	7	5
Improve safety	4	1	4	2	6	6	6	4	6	5	4	3	6	7	6
Reduce labour	6	1	6	2	7	3	7	5	7	7	7	3	6	6	7
Improve sustainability	8	1	8	2	8	4	8	5	8	7	8	3	8	6	8
Overall	1		2		3		4		5		6		7		

*RT = rank by technology, RB = rank by benefit

Rank Correlation between Smart Technologies

	AV and Robotics	AM	CPS and IoT	BD	Laser scanning	AR and VR	Blockchain	Total
AV and Robotics	1.000	0.922*	0.635	0.635	0.719*	0.719*	0.620	0.755*
AM		1.000	0.571	0.571	0.738*	0.690	0.551	0.690
CPS and IoT			1.000	1.000*	0.952*	0.905*	0.994*	0.976*
BD				1.000	0.952*	0.905*	0.994*	0.976*
Laser scanning					1.000	0.905*	0.946*	0.976*
AR and VR						1.000	0.874*	0.929*
Blockchain							1.000	0.970*
Total								1.000
*Correlation is significant at the 0.05 level (2-tailed)								

Rank Correlation between Perceived Benefits

	Improve productivity	Improve quality	Improve collaboration	Cost saving	Time saving	Improve safety	Reduce labour	Improve sustainability	Total
Improve productivity	1.000	0.436	0.127	0.450	0.688	0.109	0.147	0.055	0.582
Improve quality		1.000	-0.821*	0.180	0.721	0.893*	0.595	0.607	0.679
Improve collaboration			1.000	0.126	-0.324	-0.857*	-0.541	-0.607	-0.357
Cost saving				1.000	0.782*	0.198	0.545	0.450	0.829*
Time saving					1.000	0.613	0.682	0.613	0.955*
Improve safety						1.000	0.703	0.750	0.679
Reduce labour							1.000	0.991*	0.775*
Improve sustainability								1.000	0.714
Total									1.000

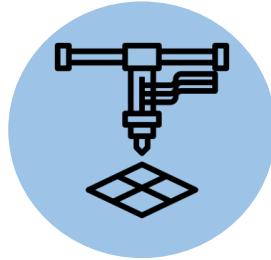*Correlation is significant at the 0.05 level (2-tailed)

Conclusion

Summary of Findings

- Autonomous vehicles and robotics
- Additive manufacturing
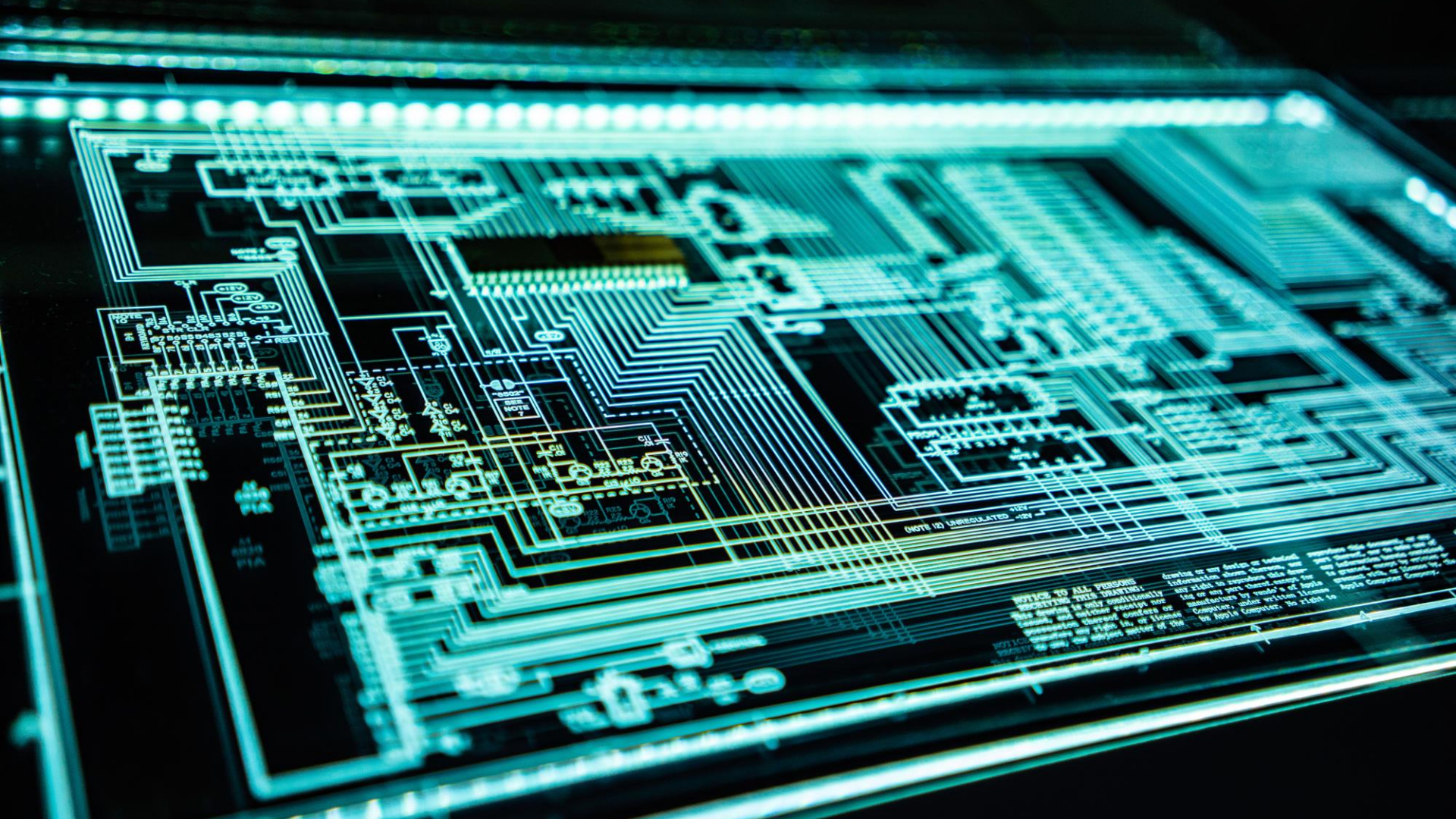- Cyber-physical system and Internet-of-Things
- Improved productivity
- Improved quality
- Improved collaboration

Q&A

THANK YOU

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