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Co-designing strategies to future-proof property workforces

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Abstract

Purpose – The property industry has been experiencing massive transformation due to rapid technological advancement in the last decade. A large body of literature has attempted to identify the challenges confronting property professionals, with some examining the impact brought by Property Industry 4.0 on the future workforce. To effectively address the challenges, however, we need participation from diverse stakeholders, as previously proposed strategies have often only considered perspectives from specific cohorts and lacked broader engagement. Hence, this study aims to formulate comprehensive strategies to address the challenges facing our future workforce in the age of Property Industry 4.0.

Design/methodology/approach – For the first time, we invited a unique lineup of stakeholders to our co-design workshops. These include property leaders, property professionals, recent property graduates, property students, property academics, program directors, as well as university leadership executives, to make sure the outcomes are relevant, effective and user-oriented.

Findings – Four strategies were recommended to future-proof our property graduates: (1) enhancing AI-focused content in universities and collaborating with industry stakeholders, (2) regulating AI adoption by bodies like the Australian Property Institute (API), (3) introducing industry certifications to address ethical concerns and (4) developing students' soft skills via internships and networking events in collaboration with professional bodies.

Originality/value – This study is the first to employ a co-design workshop, incorporating the perspectives of all stakeholders in crafting potential solutions. These include property leaders, property practitioners, recent property graduates, property academics, property students and senior school executives (e.g. deputy dean and deputy head of education).

Keywords Co-design, Property education, Real estate education, PropTech, Property Industry 4.0

Paper type Research paper

1. Introduction

Technological advancements have fundamentally transformed our lives, work environments and interactions with the world. The industrial revolutions have marked distinct stages of technological advancement since the late 1700s. Industry 1.0, the first wave of the Industrial Revolution, saw steam-powered machines replace manual work. Industry 2.0 ushered in the age of electricity, enabling mass production that set the stage for automation and digitalisation. The pace of change accelerated again with the introduction of automation and computers with Industry 3.0, increasing efficiency and productivity at factories while decreasing manual labour costs. The beginning of the internet and digitalisation of Industry 3.0 fundamentally changed how businesses manage information. The transformative technologies of Industry 4.0

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include big data analytics, Internet of Things, cloud computing, automated processes and decision making, artificial intelligence (AI) and machine learning (ML) that empowering machines to get smarter on their own and improvements in robotics (Rojko, 2017; Roulac, 2019; McKinsey and Company, 2022; Automation Ready Panels, n.d.).

Importantly, automation and AI are increasingly replacing human tasks and jobs, necessitating new organisational skill sets in the era of Industry 4.0 (PWC, 2018). Technologies such as automated decision-making, AI and ML are no longer limited to manufacturing. The technologies enabling Industry 4.0 have led to changes in the domains of property development, management, finance and valuation (Starr *et al.*, 2021). Prior to the 1990s, discussions about technology in real estate were mainly on geographic information systems (GIS) and advancements in statistical analysis techniques for property valuation. Automated valuation, such as neural networks, started to gain attention in the 1990s before the adoption of AI in real estate (Worzala *et al.*, 1995; McGreal *et al.*, 1998; McCluskey and Anand, 1999). Since the mid-2010s, articles in real estate have examined the innovations in property management (Thompson, 2015), smart technologies (e.g. blockchain) adopted in urban environments (Lecomte, 2019; Adilieme *et al.*, 2024) and the adoption of big data analytics in real estate decision-making (DeLisle *et al.*, 2020). Undoubtedly, such rapidly evolving technologies are clearly disrupting and transforming the property industry, giving rise to what is now known as Property Industry 4.0 [1], which is defined by the utilisation of digitalisation, automation, AI integration and big data in the property industry (Starr *et al.*, 2021; Lee *et al.*, 2024a). These advancements are reshaping practices and operations within the industry (Kok *et al.*, 2017; Braesemann and Baum, 2020).

Property Industry 4.0 has introduced significant changes, including Automated Valuation Models (AVMs) for property valuers, smart building technologies like augmented reality, Building Information Modelling (BIM) in property development and management, as well as blockchain and tokenisation in property investment (Wilkinson *et al.*, 2018a, b; Starr *et al.*, 2021; Elrefaey *et al.*, 2022; Marey *et al.*, 2022; Adebowale and Agumba, 2024; Adilieme *et al.*, 2024; Bouhmoud *et al.*, 2024; Khorrami Shad *et al.*, 2024). For instance, Batista *et al.* (2024) propose a solution for water management at the building scale using advanced technological resources, where automating analysis with 3D models enhances efficiency during the operational phase of buildings. The increased use of data analytics in property and fund investment has also transformed business decision-making processes (Starr *et al.*, 2021; Lee *et al.*, 2024a, b). According to a recent JLL (2023) report, AI will emerge as a significant game-changer for the property industry in the coming years.

In addition to the rise of Property Industry 4.0, the property profession faces numerous challenges in the aftermath of the pandemic. Specifically, property professionals were forced out of the office due to COVID-19 travel restrictions and lockdowns, accelerating the adoption of technology to enable work-from-home arrangements (Starr *et al.*, 2021; Lee *et al.*, 2024a, b). A study conducted in the Malaysian construction industry by Almatari *et al.* (2024) reported that the main factors inhibiting the adoption of Industry 4.0 are high implementation costs, hesitation to adopt technologies, lack of standards, legal and contractual uncertainty, as well as complexity.

In addition, Lee *et al.* (2024a) recently examined the property's future workforce and required skills for Property Industry 4.0 by conducting semi-structured interviews with property leaders. Their findings suggest that digitalisation and automation are transforming the property sectors; hence, there is an imminent need to enhance graduates' technological proficiencies to be job-ready. This echoes the finding of Almatari *et al.* (2024) and Wilkinson *et al.* (2017) that it is imperative to upskill workers to support Industry 4.0. The widespread use of AI among property professionals has prompted calls for proactive regulation, with regulators and professional bodies taking the lead (Lee *et al.*, 2024a). Additionally, while facing the challenges of Property Industry 4.0, communication skills remain a critical concern as highlighted by property practitioners (Poon, 2014; Lee *et al.*, 2024a).

Numerous strategies have been suggested to address some of these challenges (Poon, 2014; Wilkinson *et al.*, 2018a; Abidoye *et al.*, 2022), yet many studies consider perspectives from limited cohorts, lacking broader engagement. For instance, Wilkinson *et al.* (2018a) only involved property valuers in their research. To devise effective solutions, this study adopts a co-design approach involving various stakeholders, including property leaders, professionals, recent graduates, students, academics, program directors and university leadership executives. This inclusive method ensures relevant, effective and user-oriented outcomes.

While co-design (or participatory design) methods have been extensively applied in other fields – such as medical research, manufacturing, architecture, land use planning, place design, farming, engineering and public policy (Blomkamp, 2018; Lacombe *et al.*, 2018; Webb *et al.*, 2018; Zamenopoulos and Alexiou, 2018; Lainfiesta *et al.*, 2019; Trischler *et al.*, 2019; Wu and Hou, 2020; Vargas *et al.*, 2022; Busse *et al.*, 2023) – to the best of the authors' knowledge, such methods have not been adopted in property research. Having said that, co-design is frequently used in education research as a student-centred approach to curriculum design (Roschelle *et al.*, 2006; Aksela, 2019; Intal, 2021; Iniesto *et al.*, 2022; Ahmadi, 2023). Recognising the lack of adoption of co-design in property education, this paper aims to share our experience using co-design to formulate strategies to address challenges presented by Property Industry 4.0 and capitalise on opportunities within the evolving property industry.

This study contributes to the property literature in several ways. Firstly, it is the pioneering examination of potential solutions for the challenges identified in the Property Industry 4.0 era. The challenges arising from AI disruptions, the utilisation of big data and expansion of property technology are resultants of Property Industry 4.0, while deficiencies in graduates' soft skills have been further aggravated by COVID-19 lockdowns. Unlike previous studies, which often approached these challenges from a limited or singular perspective, this study includes the insights of a broader spectrum of professionals, such as developers, property managers and other property professionals. For instance, Wilkinson *et al.* (2018a) conducted focus group discussions with property valuers; and Poon (2014) included employers from property surveying firms in her questionnaire survey. By acknowledging the diversity within the property profession, this study ensures that the solutions are comprehensive and relevant to the entire property industry, rather than being confined to the narrow viewpoint of a single professional group (e.g. property valuers).

Secondly, this study is the first to employ a co-design workshop specifically tailored for the property sector. Co-design is a collective act of creativity that is particularly useful for addressing complex social issues as it actively involves participants as co-designers in formulating solutions. This approach not only facilitates the exploration of potential solutions but also engages stakeholders in problem-framing during the process (Steen, 2013; Blomkamp, 2018). By involving property leaders, practitioners, recent graduates, academics, students and senior university executives (such as deputy deans and heads of education), the co-design workshop fosters a collaborative environment where diverse perspectives contribute to a holistic understanding of the challenges at hand. This distinctive approach ensures that the solutions generated are not only inclusive but also deeply grounded in the real-world experiences and insights of all relevant parties, setting it apart from previous studies that may have relied on more isolated or narrow viewpoints.

The structure of this paper is as follows: Section 2 discusses the literature review, Section 3 outlines the research methodology, Section 4 presents the results and discussions and Section 5 provides the conclusions.

2. Literature review

This section covers two topics: the co-design approach and the emerging trends and challenges within the property industry.

2.1 Emerging trends in the property industry

The global economy has witnessed significant transformation with the arrival of Industry 4.0; the pace of change has been accelerated by the pandemic, with the need for physical distancing forcing business to embrace digitalisation and contactless operation (McKinsey and Company, 2022). Inevitably, the property industry has also been disrupted by Industry 4.0 and has increasingly incorporated transformative technologies into its new operational mode Property Industry 4.0. For instance, the increased popularity in the adoption of AI and machine learning in the development of data-driven intelligent software underlines the importance of using these systems in property and facilities management to enhance operational efficiencies (Finkenzeller *et al.*, 2010; Lecamus, 2017; CBRE, 2019). In addition, Lee and Park (2020) argue that Property Industry 4.0 has created new data to enable accurate prediction of property prices using visual information and existing metadata like building size and number of bedrooms. Having said that, data availability is key to accurately predicting real estate investment value (Sanquist *et al.*, 2018).

The following literature review critically examines the main emerging trends within the property industry, especially the significance of property technology adoption, and the skills and knowledge required by the ever-changing property industry.

2.1.1 Property technology. Property technology, commonly known as PropTech, refers to the adoption of innovation, technology and software to improve and streamline various operations within the property industry. The digitalisation and automation of property operations have been adopted to increase efficiency and effectiveness in the last 40 years. In property sales, for instance, digital marketing is a popular tool for property companies to retain existing customers (Royle and Laing, 2014) and reach new ones worldwide (Acker *et al.*, 2011; Low *et al.*, 2020). In short, the use of technology in the whole property life cycle has impacted professional practices.

Technology has also been extensively integrated into the construction industry where BIM and digital twins are the two main software dominating the market. BIM not only reduces design and construction costs but also improves productivity and risk management processes (Azhar, 2011; Bryde *et al.*, 2013; Tzachor *et al.*, 2022). Further, with the availability of smart energy data, digital twins software can also be used to identify building retrofit strategies and achieve near-real-time processing to reduce energy consumption (Francisco *et al.*, 2020). Furthermore, a comprehensive literature review performed by Ghansah and Lu (2024) uncovered enormous opportunities provided by digital twins for smart buildings and highlighted the importance of a skilled workforce to enable a seamless transition from theory to practice. A case study in the New Zealand property sector revealed that a lack of training and property education were significant inhibitors to BIM adoption (Kordestani Ghalenoei *et al.*, 2024).

Machine learning and AI, as well as blockchain tokenisation have also changed the way investors, tenants and managers invest in and manage properties (Souza *et al.*, 2021). For example, Veuger (2018) found that blockchain applications in property investment provide more effective and efficient transactions, increased transparency, a better investment foundation and new mortgage market development. Adilieme *et al.* (2024) have demonstrated that blockchain can enhance market transparency and reduce clients' influence on property valuation. Further, AI can also support investment managers in validating investment decisions by applying ML techniques to large datasets for better forecasting of housing prices (Soltani and Lee, 2024) and rents in portfolio assets (Cajias, 2021), as well as predicting housing gentrification (Thackway *et al.*, 2023).

The potential disruption of real estate crowdfunding is another area that has attracted attention in property finance literature (Montgomery *et al.*, 2018). While real estate tokenisation is increasingly popular in the property investment market (Chow and Tan, 2022), Baum (2020) warned that regulations governing the fractionalisation of asset ownership are a key challenge to tokenising single real estate assets. Similarly, there have been calls for proactive regulation of AI use in the property sector, emphasising the need for a regulator and

professional body involvement (Lee *et al*., 2024a, b). This aligns with the findings of Almatari *et al.* (2024), who suggested that government policy reform, including the re-assessment of industry standards and regulations, is essential to support the adoption of Industry 4.0 technologies.

As widely reported in the literature, AVMs were developed to reduce valuation cost and time, as well as to increase efficiency (Bellotti, 2017; RICS, 2022). Over the years, AVMs have been widely adopted by the industry, especially Artificial Neural Networks (ANNs) and GIS-based valuation (Wyatt, 1996; Huang, 2019). Other advanced valuation techniques used by valuers include hedonic pricing methods, fuzzy logic and autoregressive integrated moving averages (Pagourtzi *et al*., 2003). Hybrid AVM systems have also been adopted to improve performance in mass appraisal (Yacim and Boshoff, 2020; Hoang *et al*., 2022).

In the last decade, there has been an increased use of AVM for property valuations (Grover, 2016; Wilkinson *et al.*, 2018a; Lee *et al*., 2024a, b) as it is more efficient and accurate than the traditional valuation methods (Chaphalkar and Sandbhor, 2013; Kok *et al*., 2017; Abidoye *et al.*, 2021). Having said that, the output data will only be credible if we are confident about the quality and significance of the input data, which can vary from accurate and objective to subjective and error-prone (Helbich *et al.*, 2014; Kazimieras Zavadskas *et al*., 2018).

JLL (2023) reported that many companies recognise the strategic value of real estate technology as an enabler to enhance productivity; while many claim to have a tech vision, very few have successful PropTech programs that match boardroom ambition. As digitisation and automation are reshaping the property workforce, there is a need to bridge the gap between graduates' technology proficiency and practical application (Lee *et al.*, 2024a). As a skilled workforce is key to adopting advanced technologies, educating workers via training is imperative to support Industry 4.0 (Almatari *et al*., 2024; Ghansah and Lu, 2024).

2.1.2 Skills and knowledge. Property technology and AI transform how property professionals perform their daily practices. Threats of digital disruption and automated valuations are significant issues facing the property industry (Wilkinson *et al.*, 2018a). Therefore, graduates must equip themselves with computer technology, knowledge of relevant software and advanced statistical knowledge for the future workforce. In addition, valuers should enhance their big data analysis skills to improve valuation accuracy, and valuation companies should train their valuers in market forecasting skills (Abidoye *et al*., 2021). Further, Wilkinson *et al.* (2018b) suggested that education providers must implement curriculum changes to incorporate digital technologies and statistical knowledge and skills in order to satisfy the expectations for the future workforce of the property industry.

While knowledge of new technology is in high demand, foundational skills in communication, writing, collaboration, critical thinking and management are equally important, as they help workers move between different jobs (Dawson *et al*., 2022). This is in line with the earlier finding of Ayodele *et al.* (2021) that employers have high expectations for soft skill sets among their employees, particularly relating to responsibility, administration, listening and communication. Similar soft skills such as client care, interpersonal, writing, communication and presentation skills have been identified as a concern by human resource managers (Poon, 2014). Problem-solving abilities and time management are also crucial for property graduates (Abidoye *et al*., 2022). It is important to note that the recent research conducted by Lee *et al.* (2024a, b) revealed a concerning decline in communication skills among graduates, which is partly attributed to the COVID-19 pandemic.

Practical experience is another crucial employability factor. Callanan and McCarthy (2003) reported employers' concerns about property graduates lacking sufficient practical expertise to bridge the gap between theory and practice. The importance of commercial awareness was also highlighted as an employability skill in a study in the UK, underscoring the insufficient development of this aspect in graduates (Poon, 2014). To fill such gaps, industry internships are essential to provide students with a structured work experience to acquire the necessary knowledge and skills (Wilkinson *et al*., 2018a; Lee *et al*., 2024b). This is consistent with an earlier study highlighting the importance of intertwining industry and academia through

mentoring and internships for program enhancement (Manning *et al.*, 2007). More importantly, it is crucial to foster strong ties between professional bodies, universities and practitioners to facilitate the transfer of practical knowledge and real-world experience to students (Wilkinson *et al.*, 2018b; Gunarathna *et al.*, 2024; Lee *et al.*, 2024a, b).

As suggested by Collin *et al.* (2012), continuing professional development (CPD) can vary from formal educational courses to learning through everyday work practices. Short courses are the most common CPD for professionals to update their knowledge. For property professionals, CPD is important to keep them abreast of the latest knowledge and skills related to their profession (Wilkinson *et al.*, 2018b). A skilled workforce is vital in adopting Industry 4.0 technologies; for instance, in construction, educating workers to make sure they are competent in implementing new technology to stay competitive (Almatari *et al.*, 2024). As suggested in an earlier study, employers must consider the skills of the current workforce's future skill requirements and embrace lifelong learning to bridge this gap (PWC, 2018). However, some argue that employees are responsible for updating their skills rather than relying on any employer (PWC, 2018).

In summary, while the existing literature extensively discusses the challenges facing the property industry, only a handful of studies suggest solutions and often only engage a certain group of stakeholders. To formulate comprehensive strategies to address these challenges, we adopted co-design workshops in this study, involving various stakeholders to ensure the outcomes are relevant, effective and user-oriented.

2.2 Co-design

Terms such as co-production, co-creation and co-design are often used interchangeably to describe collaborative processes where stakeholders work together to develop solutions or design something (Brandsen and Honingh, 2018). Co-design originates from the participatory design from the 1960s in Scandinavia, where there was an increasing need to consider the community perspectives in key decision-making processes (Bodker, 1996). According to Wang and Hannafin (2005, p. 6), participatory design "involves collaboration between researchers and participants, local practices that support systematic theorising, and improvement in both theory and practice".

In other words, co-design is a collective act of creativity that is useful for addressing complex social issues where participants as co-designers are actively involved in formulating solutions (Sanders and Stappers, 2008; Steen, 2013; Blomkamp, 2018; Zamenopoulos *et al.*, 2021). Recognising that creativity exists at varying levels among the participants, researchers need to facilitate creative expression, including leading, guiding and offering support to encourage individuals' expression of ideas (Sanders and Stappers, 2008). In addition to exploring solutions, Neef and Nuebert (2011) suggest that co-design also involves problem-framing in the process of co-design. To put it another way, co-design involves a practical view, and it is regarded as a tool that produces a shared language between stakeholders and designers to understand a new "product" from the perspective of everyone involved in its development and use (Dodero *et al.*, 2014). As a result of the recognised benefits of co-design, it has been widely implemented in various fields including the production industry, architecture, land use planning, medical, engineering, public policy and education.

According to David *et al.* (2013), the beginning of co-design could be linked to two design approaches: user-centred design and participatory design. For example, Shah *et al.* (2009) argue that the development of medical devices should involve healthcare professionals and end users, including patients, people with disabilities and/or special needs and their caregivers. Furthermore, the research evidence shows that such end users quickly discard devices that fail to meet their personal expectations, even though both manufacturers and healthcare professionals may consider that those end users' requirements have been satisfied. Despite a divide between end product and product design in manufacturing, it is of vital importance to emphasise the role of end user-producer interaction (Castellacci, 2008).

Consistent with earlier research, co-design is recognised as a powerful tool that empowers end users by involving them in the design process, allowing them to have a say in the products and services designed for them (Walsh *et al.*, 2013). In short, co-design involves diverse stakeholders, including end users, in the design of a product or solution that best serves the user's requirements. In Slinger *et al.*'s (2023) paper, a co-design method was used to engage local people to devise solutions for flood defence. The results indicate that the focus on collaboration was instrumental in initiating a more open discourse on flood defence options. Similarly, co-design is a popular approach used in land use science to address complex sustainability challenges (Busse *et al.*, 2023), in which Blomkamp (2018) and Lacombe *et al.* (2018) refer to jointly developing concrete solutions or "tangible artefacts".

In the field of education, co-design is recognised as pivotal for promoting twenty-first century competencies and practices (Noweski *et al.*, 2012; Kelly *et al.*, 2019). What's more, a co-design method is seen as instrumental in updating curriculum, enhancing student engagement and learning outcomes. It is further useful for developing new solutions and pedagogical innovations (Aksela, 2019). Using a co-design process, education practices are updated through systematic, flexible and iterative analysis, and innovative solutions are often produced to overcome complex challenges in teaching and learning (Wang and Hannafin, 2005).

Although a teacher-centred approach has long been practiced by educators, it is essential to design authentic learning scenarios by focusing on students' interests and their needs (Garcia *et al.*, 2018). Several studies mention the involvement of students in helping teachers better adapt to students' needs and learning preferences (Gärdebo and Wiggberg, 2012; Nygaard *et al.*, 2013). Along with this, the "student engagement" approach suggests that enabling students' participation may encourage them to take control, reflect and become aware of their learning process, promoting the adoption of deeper learning approaches (Bain and Zimmerman, 2009).

A central tenet to the co-design approach in education is teachers relinquishing some control to students' needs and being open-minded to their opinions (Cameron and Tanti, 2011). According to Little and Williams (2010) and Garcia *et al.* (2018), students highly value their involvement in the decision-making process in course design. However, we also find that there are constraints in co-design within education as highlighted by Garcia *et al.* (2018): "what is possible in co-design, what students bring and what the process gives back to them all depend on several factors such as the discipline, the culture of the institutional professional bodies involved, the university teaching model, the teachers' and students' level of expertise and confidence in this type of participatory process".

Although co-design has gained much recognition by researchers across many disciplines as discussed above, it has received limited attention in property education. To the best of our knowledge, there are no publications on co-design in real estate education thus far. Given co-design is becoming increasingly prevalent in educational research, this paper is designed to illustrate how co-design is adopted in our project to formulate solutions in facing the challenges presented by Property Industry 4.0.

3. Research methodology

Facing the unprecedented challenges of Property Industry 4.0, such as AI disruptions, the utilisation of big data and the rise of property technology, along with the changing requirements of the property profession, our study aims to formulate comprehensive strategies to address these issues and incorporate them into the property curriculum. Co-design is deemed appropriate as it is a participation-based collaboration between researchers and diverse stakeholders in problem-framing and formulating solutions (Neef and Neubert, 2011). We conducted a series of co-design workshops to determine what is expected from the industry and how we should address the expectations.

Co-design involves active participation from all participants. Their invaluable input ensures that outcomes are relevant, effective and user-oriented. Selection of participants in the co-design is an important process to gain a comprehensive overview of all stakeholders (Lock *et al.*, 2021). The traditional feedback process in stakeholder engagement often includes a 360-degree approach involving people directly engaged with and impacted by the proposed program or decisions (Steen, 2013; Blomkamp, 2018). In this research, the co-design acknowledges not just direct stakeholders but also the importance of the continuous learning process. Hence, the co-design process in this study included students, practitioners, property leaders and academics as well as recent graduates. Ethical clearance was obtained prior to conducting the workshops.

Forty participants were involved in this study. Four co-design workshops were conducted, involving various stakeholders such as undergraduate and postgraduate students, property practitioners, property leaders, program directors, an associate dean and an associate head of education. These 40 participants for the four workshops were carefully recruited to ensure a diverse and representative sample of stakeholders relevant to the property industry and education. Undergraduate and postgraduate students were invited through university mailing lists and student representatives, ensuring the inclusion of individuals with direct experience in the property curriculum. Property practitioners were recruited via established industry networks, including professional organisations and associations, to incorporate practical insights into industry expectations and workforce challenges. Academic leaders, including property course directors, an associate dean and an associate head of education, were approached directly through institutional networks to secure their strategic expertise in curriculum design and education policy. The recruitment process was guided by a deliberate effort to balance perspectives across stakeholder groups, ensuring a holistic approach to curriculum development.

The selection criteria emphasise participants' relevance to the study objectives, prioritising those with insights into the challenges and opportunities facing the property industry. Undergraduate and postgraduate students were included for their ability to bring fresh and innovative perspectives, while property practitioners contributed practical knowledge of industry trends, such as AI disruption, PropTech and soft skills. Academic leaders offered their expertise in aligning educational frameworks with industry requirements. Ethical considerations were integral to the recruitment process, with all participants receiving detailed information about the study and providing informed consent before participating. The final group of 40 participants, distributed across the four workshops, was deemed sufficient to generate meaningful insights while maintaining an interactive and collaborative workshop environment.

Although challenges and opportunities have been identified through the literature review, our co-design process is flexible and grants participants maximum freedom to voice their opinions. This is in line with Steen's (2013) suggestion that the research plan has to be flexible and take co-design as a "process of framing", in which participants creatively and iteratively move between problem-setting and solution-finding. The goal of a co-design workshop is to foster collaboration and generate innovative ideas, valuable insights and practical solutions that meet the diverse needs and perspectives of all participants (Steen, 2013; Lacombe *et al.*, 2018). Plate 1 shows one of the co-design workshops held in December 2023.

Throughout the workshops, feedback on the key themes, assumptions and identified challenges were incorporated incrementally into each subsequent session, guiding the development of practical recommendations for the property curriculum. Each workshop followed a standard approach, beginning with an overview of the study's focus and findings. Participants were introduced to findings from earlier research (i.e. interviews and initial results from the survey), covering themes such as AI disruption, the utilisation of big data and soft skills deficiencies. This was followed by collaborative group activities lasting approximately 90 min, and a general discussion to synthesise and refine the outcomes. At the end of the co-design process, team leaders were then required to present their findings and

Source(s): The Authors

Plate 1. Co-design workshops

recommendations. A consensus on these recommendations and findings was sought at the end of the workshops.

The first workshop began with undergraduate students ($n = 9$), aiming to capture their fresh perspectives and innovative thinking on the future of the property curriculum. The workshop encouraged students to brainstorm and propose creative solutions to address these industry challenges. Their contributions provided insights that challenged conventional approaches and highlighted potential areas for curricular enhancement.

Workshop 2 ($n = 8$) focused on designing property curriculum to meet specific challenges of Property Industry 4.0 from the perspective of postgraduate students, who offered more advanced and professionally informed perspectives. Building on the findings shared in the first workshop, participants explored how challenges like AI and PropTech intersect with their academic experiences and professional aspirations. Their input focused on how the curriculum could integrate advanced technical skills, ethical considerations and global competencies to better prepare graduates for industry demands.

Following the feedback from these two workshops, workshops 3 ($n = 15$) and 4 ($n = 8$) involved property practitioners, property course directors, an associate dean and an associate head of education. Workshop 3 was conducted in Sydney, with discussions centred on aligning the curriculum with real-world industry needs and ensuring its relevance in a rapidly changing professional landscape. Key topics included AI disruption and PropTech advancements, with participants offering insights on how the curriculum could bridge the gap between academia and industry, enhancing employability and fostering innovation.

Workshop 4 brought together property practitioners and educational leaders in Brisbane, focusing on the localised context of the property industry. Building on the themes discussed in the Sydney workshop, participants explored how regional challenges and opportunities could influence the design of the property curriculum. The discussions generated valuable region-specific insights to complement the national perspective, ensuring the curriculum addresses both broad trends and localised needs.

4. Results and discussion

The four co-design workshops conducted across Sydney and Brisbane aimed to formulate strategies to address the future challenges for Property Industry 4.0 as outlined in Section 3 *Research Methodology*. Prior to the workshop, the research team presented several issues affecting the sector, as identified from interviews and surveys undertaken in a previous stage of the overall research project. The summarised findings included the key challenges that property graduates will need to address to perform in the Property Industry 4.0 era, such as issues on AI adoption and soft skills. The research team facilitated the co-design workshops to develop strategies to optimally address the identified future challenges in property programs. The results from the four co-design workshops are presented in Section 4.1, and a discussion of the results is included in Section 4.2.

4.1 Results

The co-design workshops provide a dynamic platform that enables diverse stakeholders to share their insights and expertise (Steen, 2013; Blomkamp, 2018). Notably, the multifaceted discussions and creative exchanges among the participants have given rise to valuable recommendations to address the identified challenges. The following discussion outlines the key proposals resulting from the participative and collaborative effort in the co-design workshops; it features the innovative solutions and actionable strategies developed through this inclusive approach. Using thematic analysis, the data collected from the four co-design workshops were analysed and categorised into two broad themes: challenges and recommendations, as described below.

4.1.1 Challenge 1: AI disruption challenges. Property Industry 4.0 has brought significant changes to the industry including the adoption of digitalisation technology, AVMs and BIM in the property industry (Wilkinson *et al.*, 2018a; Starr *et al.*, 2021). Through in-depth discussions in the co-design process, participants identified recurring themes concerning how future property professionals perceive AI and its practical application within the property industry. They linked AI to an individual's or corporation's strategic decision-making and adaptability. Generally, companies perceive AI as a transformative technology with great potential to improve business performance and stay competitive and relevant in the marketplace.

Accordingly, participants predicted AI implementation in property as something capable of becoming a routine practice integrated into daily work, in which they can employ their cognitive abilities to address property-related challenges. One of the suggestions is to enhance educational activities concerning AI as the participants believed that the property industry would increasingly leverage AI in various ways. Their recommendation for universities to strengthen their teaching on AI indicates the recognition of technology's growing role in shaping future practice within the property sector. This acknowledgement emphasises the need for educational institutions to align their curricula with the emerging trends and technological advancements in the property industry, ensuring property graduates are well-equipped to navigate and contribute to a landscape increasingly influenced by AI applications.

Also, it's worth noting that the postgraduate student cohorts proposed that universities should design assignments requiring students to use generative AI, such as ChatGPT. This is necessary as it assists students in better understanding the usefulness and limitations of AI. This is in line with the findings of Lee *et al.* (2024a), where property leaders expressed concern that students were unable to apply AI to the property context appropriately.

Recommendation 1: Universities should integrate AI technologies into course curricula in response to their increased use in the property industry. While core property knowledge must be prioritised, AI integration is required to ensure our graduates are prepared to navigate a property sector evolving with advancements in AI. Hence, AI should not be a standalone subject but should be integrated into relevant property subjects to examine how various technologies can be harnessed by industry practitioners.

Recommendation 2: Due to the increased use of AI in the property industry, it is crucial for professional bodies such as API to play a regulatory role in overseeing its adoption. Essentially, this regulatory function would protect the interests of various stakeholders, ensuring ethical use and responsible practices in addition to confirming industry standards. This could be achieved via a certification process, and people could be reprimanded if they did something unethical. In short, governance is central to ensuring AI is used responsibly and appropriately; hence, potential ethical concerns should be addressed from the outset. Ideally, AI best practices should be promoted in universities and among property professionals to cultivate a responsible culture.

4.1.2 Challenge 2: utilisation of big data and expansion of PropTech. For property and asset management, participants agreed that by embracing big data and PropTech, property practitioners can make informed decisions, improve operational efficiency and deliver enhanced tenant experiences. For example, data-driven decision-making enables us to analyse extensive datasets more effectively and efficiently, providing insights into market trends and investment opportunities.

Furthermore, PropTech tools help practitioners assess risks associated with property investments and leverage big data analytics to forecast market trends, thereby enabling more informed decision-making (Veuger, 2018; Souza *et al.*, 2021). Without a doubt, the significance of the integration of business analytics in property analysis is growing. The API's new certification, Certified Property Data Analyst, is testament to the importance of big data in the property industry. Inevitably, this certification is timely in assisting property professionals to be ready to adapt to the ever-changing landscape.

Participants also agreed that PropTech streamlines property management and facilities management operations through automation, improving efficiency in maintenance, tenant communication and lease management. As highlighted in the literature, the rising level of adoption of AI and machine learning is key to improve operational efficiencies in property and facilities management (Finkenzeller *et al.*, 2010; Lecamus, 2017; CBRE, 2019). For instance, big data helps optimise building operations by monitoring energy usage, predicting maintenance needs and enhancing overall building efficiency and sustainability. Further, big data and PropTech enable personalised tenant experiences, from tailored leasing options to responsive property services, fostering tenant satisfaction and loyalty.

At the same time, participants also voiced their concerns about graduates' analytical abilities, adding that property professional bodies and universities could develop training programs to enhance practitioners' skills in utilising big data and PropTech tools. It is essential to offer continuous professional development programs through workshops and seminars to ensure property practitioners stay updated on the latest advancements and best practices in using big data and PropTech.

In addition, concerns about ethical issues and secured technology integration have been raised in the discussion. To counter these concerns, property professional bodies and higher institutions must work together to establish and uphold industry standards. One of the suggestions is to advocate the API's Data Analyst certification to ensure that technology solutions, especially in the context of big data and PropTech, adhere to ethical practices, data privacy regulations and cybersecurity standards. By promoting and requiring API certification, professionals can confidently integrate technology solutions, fostering a secure and responsible environment for using big data and PropTech within the property sector. This commitment to ethical standards would enhance the credibility of technology applications and safeguard the interests of various stakeholders and the broader community.

Recommendation 3: API's Property Data Analyst certification should be promoted widely by professional bodies as an industry standard to ensure ethical and secure technology integration. This could be implemented via continuous professional development programs like workshops and seminars, fostering a culture of innovation and ethical practices. It is also important for big data activities and utilisation to be regulated by API to ensure privacy is protected. What's more, universities should integrate business analytics into property

education curricula to better prepare students for the growing significance of big data application. We are hopeful that, collectively, the universities and the industry could cultivate a tech-savvy, ethically responsible workforce to navigate the intersection of real estate and technology.

4.1.3 Challenge 3: graduates' soft skills deficiencies. As discussed above, several critical soft skills deficiencies including graduates' communication skills and limited property knowledge were highlighted in the literature (Poon, 2014; Lee *et al.*, 2024a). Both students' and industry practitioners' groups had brainstormed effective strategies to overcome these weaknesses. They suggested embracing a comprehensive approach, actively encouraging and facilitating students' participation in diverse settings such as internships, community projects and industry-related activities. This is consistent with literature highlighting the importance of collaboration between the industry and academic through internship program (Manning *et al.*, 2007; Wilkinson *et al.*, 2018a). Through such programs, students gain invaluable opportunities to apply and refine their communication skills by immersing themselves in these real-world scenarios. Without a doubt, engaging with actual workplace dynamics, interacting with diverse stakeholders and navigating industry-specific challenges contribute significantly to developing enhanced verbal and written communication abilities. This hands-on participation not only reinforces theoretical learning but also promotes a practical understanding of how communication operates in professional contexts, preparing students for the dynamic landscape of their future careers.

Due to globalisation, the property industry now draws talent from various cultural backgrounds; hence, multiculturalism, diversity, equity and inclusion are becoming increasingly important in the property industry. Given property is a people-oriented industry, we must learn to be able to present and communicate effectively with people from diverse cultural backgrounds. Most participants agreed that group work, presentations and networking programs are essential as these activities would enhance students' written and verbal communication abilities.

Graduates have been shown to demonstrate proficiency in software applications but exhibit limitations in property knowledge (Lee *et al.*, 2024a, b). To overcome this weakness, property graduates are urged to engage proactively in property-related networking events, both online and offline, in order to establish connections with professionals and enhance their knowledge base. New graduates are encouraged to join industry associations or groups to tap into valuable resources, engage in discussions and explore learning opportunities provided by seasoned practitioners. What's more, graduates are advised to work closely with colleagues or professionals who are experts, fostering knowledge sharing and cross-functional learning.

Though internships and work experience are recognised as crucial for property students to improve their soft skills, dedicated support from API (Wilkinson *et al.*, 2018b) is also important, where their members could assist in providing work opportunities to students. Undoubtedly, API, as the prominent professional body in Australia's property industry, should also play an initiative-taking role in promoting the profession to the younger generation.

Recommendation 4: There must be a concerted effort among property educators, property practitioners and professional bodies to address soft skills deficiencies in graduates, particularly in communication skills and property knowledge. For example, professional learning programs such as internships and property-related networking events should be incorporated to enhance communication skills and domain knowledge. In addition, property educators should promote group work and presentations in addition to designing more interdisciplinary projects for students to develop a holistic skill set. Furthermore, API could adopt a more proactive role through its members' network to support work experience initiatives to enhance students' communication skills and property market-related knowledge.

4.2 Discussion

Co-design is a collaborative process among the participants that effectively develops solutions to address complex problems (Sanders and Stappers, 2008; Steen, 2013; Blomkamp, 2018). In this study, the co-design groups attempted to collect a range of perspectives to develop recommendations to address the significant challenges confronting future property graduates entering Property Industry 4.0. The challenges and recommendations generated from the codesign workshops are depicted in Table 1.

Co-design goes beyond exploring solutions to identified issues; it also involves collaborative problem-framing as a part of the process (Neef and Nuebert, 2011). The workshops were facilitated by the research team; however, participants were given the open floor to discuss their opinions in detail. Overall, there was consensus across the four co-design workshops on the challenges confronting professionals in the Property Industry 4.0. era and the corresponding recommendations. However, it is important to note variations in the emphasis placed on these challenges and recommendations across the workshops. For example, at the co-design workshop that was held for undergraduate students and recent graduates in Brisbane, there was a lot of interest in collaboration with industry bodies and the property industry to provide opportunities for site visits and internships. This was seen as being essential in creating a "work-ready" property graduate.

Both undergraduate and postgraduate groups acknowledged the significant role of AI. While the undergraduate students shared their experience of using ChatGPT in completing their assessments, the postgraduate group from the workshops in Sydney recognised the importance of AI at their workplace and suggested that AI should be incorporated in the property curricula, but it should not be a standalone subject. While acknowledging the challenges presented by AI, the industry practitioners, the property leaders and the program directors were worried about the ethical application of AI. They raised concerns about the integration of AI and the regulatory role that professional bodies can play in regulating the use of AI. The participants asserted that a strong regulatory framework from the professional bodies is essential and one of the suggestions was to advocate the API's Data Analyst certification to ensure ethical practice in the utilisation of big data and PropTech.

Generally, students accepted the importance of communication skills for their future careers. However, industry practitioners highlighted a concerning deficiency in soft skills among graduates. In response, property academics, senior executives and industry practitioners discussed strategies to enhance these skills, including incorporating group work and presentation into assessments, in addition to providing field work, mentoring and internships opportunities. A strong recurring theme from each of the co-design workshops was the pressing need for effective collaboration between universities, industry and professional bodies to address the challenges of Property Industry 4.0.

Table 1. Summary of findings from the co-design workshops

Challenges	Recommendations
AI disruption	AI technologies integrated into property course curriculum Professional bodies to oversee regulatory role in AI adoption
Utilisation of big data and expansion of PropTech	Property data analyst certification by professional body to ensure ethical and secured technology integration
Graduates' soft skills deficiencies (especially in communication skills and property knowledge)	Collaboration across stakeholders - Property educators - Property practitioners - Professional bodies

Source(s): Authors' own work

To validate the findings, peer review and feedback were sought from a distinguished professor in property with more than 45 years' experience in property education and research. Additionally, expert validation was pursued through industry conferences and academic seminars, which serve as critical forums for engaging academics and practitioners to assess the credibility and relevance of research findings. Such discussions, both during and after presentations, often highlight potential oversights or provide valuable new insights, as recommended by Wang *et al*. (2022). Specifically, the findings from the co-design workshops were presented at four international and domestic forums, where open feedback and discussion were actively encouraged. Presenting the research at these conferences not only enhanced the reliability and credibility of the co-design findings within the academic and professional communities but also ensured a thorough evaluation by diverse stakeholders.

Overall, audience feedback aligned with the challenges and recommendations identified in the workshops. There was broad agreement that AI represents a transformative force for Property Industry 4.0, while addressing the deficiency in graduates' soft skills remains a critical priority. Stakeholders emphasised the need for close collaboration among academia, the property industry and professional bodies to effectively future-proof property graduates for the evolving demands of the sector.

While the recommendations outlined above provide a foundation for equipping property graduates and professionals with the skills and knowledge needed to succeed in the rapidly evolving property industry, future research could investigate the specific details and practical aspects of their implementation. This includes exploring specific strategies and frameworks that can ensure these recommendations are effectively adopted and tailored to meet the demand of Property Industry 4.0. Such research would not only enhance the implementation process but also improve the likelihood of achieving the desired transformative outcomes in the property profession.

5. Conclusion

While recent studies have investigated the challenges facing the future workforce in the Property Industry 4.0 era, few have identified effective strategies. This study, therefore, aims to develop comprehensive strategies to address these challenges through co-design workshops. Co-design is a participative approach that brings out diverse viewpoints from various stakeholders through discussions. The fundamental principles of design-based research are to address complex problems in real-life contexts and then focus on rendering plausible solutions (Kennedy-Clark, 2013).

Although many other disciplines have adopted co-design approach, to the best of our knowledge, this method has seen limited application in property education. In this study, co-design workshops were held to discuss key challenges in the property industry, including AI disruptions, the use of big data and PropTech and deficiencies in graduates' soft skills. Participants were tasked to devise solutions addressing these challenges. Collaborations, brainstorming, and creative exchanges among the participants were found to be instrumental for the groups in developing strategies to address the challenges facing presented by Property Industry 4.0. Four key themes or recommendations derived from the co-design workshops are summarised as follows:

(1) *Recommendation 1:* Universities must increase AI-focused content and integrate AI into relevant property subjects and collaborate with industry stakeholders.

(2) *Recommendation 2:* Professional bodies like API should take a greater role in regulating AI adoption in the property industry.

(3) *Recommendation 3:* Industry certification, such as API's Certified Property Data Analyst, should be promoted as a regulatory measure to address ethical concerns.

(4) *Recommendation 4:* Engagement initiatives such as internships, networking events, group work and presentations should be promoted to enhance students' soft skills.

As discussed above, the collaborative insights from industry leaders, practitioners, educators and students provide a comprehensive understanding of the challenges and opportunities shaping the future property workforce. More importantly, their recommendations underscore the pivotal role of higher education, professional bodies and industry partners in preparing an adaptive, ethically responsible workforce capable of navigating the complexities of the evolving property landscape. Through the thoughtful implementation of these recommended strategies, future workforces will hopefully be more resilient, innovative, responsible and ethical, contributing to the sustainable future of the property industry.

Although the recommendations outlined above are instrumental for future-proofing property graduates and professionals, future research may focus on the finer details of their implementation to achieve the desired outcomes. For example, research may explore the precise AI content to be integrated into the curriculum and the practical approaches to collaborating with industry partners. Besides, as this research was limited to the Australian context, future studies may look beyond national boundaries to examine what has been practiced globally to prepare property workforces for the future.

Notes

1. While Industry 4.0 refers to the emerging fourth industrial revolution and digitalisation of industry technologies and processes, Property Industry 4.0 refers to the utilisation of big data, AI and digitisation technology, specifically, in the property sector.

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