

Authors



Lachlan Nimmo,  
Dr Greg Usher

Corresponding author:

Dr Greg Usher  
Enso Consulting:  
[greg.usher@ensoconsulting.com.au](mailto:greg.usher@ensoconsulting.com.au)

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# 'Job-ready' project managers: Are Australian Universities preparing managers for the impact of AI, ML and Bots?

## ABSTRACT

### Synopsis

Society stands on the threshold of the 4<sup>th</sup> Industrial Revolution, a change that will see Artificial Intelligence (AI), Machine Learning (ML) and Robotisation (bots) take a central role in global economic and labour markets. The profession on project management must be impacted by these changes, and this research explores whether Australian Universities are preparing project managers to be 'job-ready' in this light of this

### Relevance for Research and Education

This research explores the current project management education offerings in Australian Universities and compares these to current and/or future developments project management AI, ML and Bot technology.

### Research Design

This research uses a Grounded Theory methodology. Two data were collected and analysed. The first data were gathered from current project management courses offered by Australian Universities. These were categorised by the subjects offered and the duration of each course. The second data were gathered from project management "Educators", "Developers" and "Practitioners" and explored the types of knowledge and skills these groups expected would be required in the coming 1,3,5 and 10-year time horizons. The data from each analysis was reviewed using a comparative assessment of education offerings against current and future project management skills.

### Main Findings

This research concludes that the field of project management will see AI, ML and Bots having a significant impact on both 'hard skill' and 'soft skill' based tasks and processes within the next five - ten years. The research finds conclude that Australian Universities have, at best, 3 'teaching cycles' to make the necessary changes, and that a failure to change project management curricula within the next five years will result in university graduates who are not 'job-ready' for the profession of project management

### Research Implications

Our research has implications for both project management educators and practitioners. We found the impacts of the 4<sup>th</sup> industrial Revolution have the potential to significantly change the requirements for project management education and practice

### Keywords

artificial intelligence, machine learning, bots, education, Australian Universities.

## **INTRODUCTION**

Society stands on the threshold of a new Industrial Revolution (Trevelyan 2018). This will be the fourth industrial revolution that we have entered, and history tells us that not all industries and professions will survive (Skilton & Hovsepian 2017). However, the challenges this revolution will bring do not necessarily need to be feared, as they are fundamental to progress. As Schumpeterian economics highlights, the process of creative destruction fundamental to continuing progress. The old must make way for the new (Reinert & Reinert 2006).

The 4th Industrial Revolution will see Artificial Intelligence (AI), Machine Learning (ML) and Robotisation (Bots) taking a central role in global economic and labour markets (Feuillet 2019). Even as this paper is being written we are experiencing fundamental changes to our understanding of labour markets (Trevelyan 2018), wealth distribution (Castelluccio 2019), universal basic income (Feuillet 2019), knowledge-based, rather than time-based, economies (LeVine 2014) and even the 'personhood' of AI (Feuillet 2019).

For years professionals and knowledge workers have watched as robotization has assumed blue-collar roles, safe in their belief that the intellectual complexity required to undertake their own roles created entry hurdles that were unassailable for AI (Trevelyan 2018). However, things are changing, and they are changing quickly. A recent study indicated that as many as 30%-40% of 'knowledge workers' roles in the USA, UK, Germany and India will be replaced by AI by the year 2030 (Rao & Verweij 2017). In fact, it has been claimed that "...almost every job where an employee sits in front of a computer screen and either processes or interprets data is at high risk [of being replaced by AI or bots]..." (Els de Wind in Trevelyan 2018).

The 4th Industrial Revolution has already seen significant impacts on traditionally 'unassailable' roles, with AI, ML and Bots already impacting lawyers (Goodman 2019; Sjöberg 2019), accountants (Zhang, Dai & Vasarhelyi 2018), data analysts (Reinhardt et al. 2018) and economists (Bughin et al. 2018). There can be no doubt that this continued rise in the application of AI, ML and Bots must, and will, trigger a tectonic shift in the global understanding of the workforce at a scale never seen before in human history (Prieto 2019).

It stands to reason then, that the profession of project management will not be left untouched by this new revolution. It is therefore essential for us, as researchers and practitioners, to understand how these changes will impact our profession so that we can prepare, not only ourselves but the generations of project managers that follow us for the future they will inherit. To this end, this paper will explore whether Australian Universities are preparing project management students to be 'job ready' at the dawn of the 4th Industrial Revolution.

## **LITERATURE REVIEW**

### ***AI, ML and Bots in Project Management***

The terms Artificial Intelligence, Machine Learning and Robotisation are appearing in more and more literature. Often these terms are mistakenly used interchangeably, when in fact they are different elements of the 4th Industrial Revolution (LeVine 2014). For clarity, this paper uses the following definitions:

**Artificial Intelligence (AI):** a computer system that can undertake tasks normally associated with human intelligence such as decision-making, visual and speech recognition and language translation (Oxford 2019).

**Machine Learning (ML):** A subset of AI that moves away from strict rule-based programming and instead uses mathematical algorithms to test assumptions from existing data and create predictions based on a self-created probabilistic model (Prieto 2019).

**Robotisation (bots):** A subset of AI. A device, piece of software or an application that can perform routine and mundane tasks with minimal human intervention (Dictionary.com n.d.; Technopedia n.d.).

Within the field of facilities construction (which is the focus of this research) AI, ML and Bots are already beginning to impact the tasks associated with traditional project management (Eastman et al. 2011; Feuillet 2019). The Global Construction Survey conducted by KPMG (2019) indicates that of the top 20% of construction firms 69% have already commenced the integration of AI, ML and Bots into project management tasks. These tasks include program scheduling and resource planning (Prieto 2019), procurement (Bell & Olomolaiye 2012), identifying trends in risk assessments (Prieto 2019), communications such as drafting minutes, registers and reports (Feuillet 2019), and even the drafting and assessment of intelligent contracts (Mason 2017).

It would be easy, and perhaps a somewhat justified, to view the impact of AI, ML and Bots on the field of project management with an air of trepidation. The current rate of techceleration will undoubtedly result in the obsolescence of some of the tasks that project managers have considered their sole domain for the past few decades (Eastman et al. 2011). However, as Feuillet (2019) has noted: "...in the near term AI will likely replace tasks rather than jobs..." (p.1). Other authors have focused on the benefits that AI can bring to the profession of project management, noting that the use of AI, ML and Bots to undertake routine, repetitious or mundane activities will provide project managers more time to undertake value creation activities, rather than administrative processes (McNamara & Sepasgozar 2018; Pant & Baroudi 2008). This shift in the practice of project management will, out of necessity, create a shift in the education of project managers.

### ***Project Management Education***

Berggren & Söderlund (2008) note that "...project management education is an important field for a growing body of Universities..." (p.295). However, project management education in Universities has attracted criticism in recent years. The educational offerings have been accused of using over-simplified models and bodies of knowledge (Berggren & Söderlund 2008) which lack relevance to practice (Winter et al. 2006). Crawford et al. (2006) make the claim that most University project management courses are often "...pitched at the same level as certificate and commercial training in project management bodies of knowledge..." (p.724).

Furthermore, Adams (2016) has argued that most project management courses offered in Universities are based on a single project management methodology - PMBoK ®. This claim is supported by Thomas & Mengel (2008) who even go as far as stating that PMBoK ® has become the "... defacto global standard for project management..." (p.1).

It is easy to understand why this particular methodology has been adopted as a foundation for the majority of project management courses. PMBoK ® provides a framework that can easily be converted into a project management syllabus. This framework contains 10 project management knowledge areas:

- (i) Integration Management;
- (ii) Scope Management;
- (iii) Schedule Management;
- (iv) Cost Management;
- (v) Quality Management;
- (vi) Resource Management;
- (vii) Communications Management;
- (viii) Risk Management;
- (ix) Procurement Management; and

(x) Stakeholder Management.

(Project Management Institute (U.S.) 2017)

These knowledge areas produce 50 project management processes which can be categorised into five process groups (Project Management Institute (U.S.) 2017). These processes and process groups create a logical outline for teaching the 'traditional' project management skills (Akhmetshin et al. 2019; Bergman & Gunnarson 2014). Table 1 provides a summary of these processes categorised into the five process groups.

Table 1: Project Management Processes by Process Group

Initiating	Planning			Executing	Monitoring and Controlling	Closing
Project Charter	Project Management plan	Requirements Management Plan	Cost Management Plan	Project Status Report	Change Request	Lesson learnt
Stakeholder Register	Scope Management Plan	Requirements Documentation	Activity Cost Estimate	Deliverable status	Change Log	
	Project Funding Requirements	Requirements Traceability Matrix	Cost Baseline	Change Request	Earned Value Status Report	
	Quality Management Plan	Process Checklists	Product Quality Checklists	Project Team Directory		
	Quality Metrics	Project Scope Statement	Scope Baseline	Team Performance Assessment		
	Schedule Management Plan	Milestone List	Project Schedule Network	Enterprise Environment Factors		
	Communications Management Plan	Activities Attributes	Process Management Plan	Procurement Agreement		
	Risk Management Plan	Risk Register	Change Request	Issue Log		
	Resource Breakdown	Activity Resource Requirements	Activity Duration Estimates			
	Resource Project Calendar	Procurement Management Plan	Make-or-Buy Decisions			
	Stakeholder Management Plan	Project Schedule	Procurement Statement of Work			
		Schedule Baseline				

Adapted from visual-paradigm (2019)

However, the PMBoK® framework is not without its critics. Many authors have noted that PMBoK® focusses heavily on the 'hard skills' of project management (Adams 2016; Marando 2012; Narh 2013; Pant & Baroudi 2008). 'Hard skills' can be thought of as the technical competencies which result in tangible project deliverables (Adams 2016). Deliverables such as project plans and charters, work breakdown structures, risk registers, project scheduling and monitoring, critical path analysis, cost monitoring and controlling, scope management, as well as managing deviations from agreed time, cost and scope requirements (Adams 2016; Marando 2012; Usher & Whitty 2017b). These 'hard skills' are the core competencies of project management traditionally associated with the 'Iron Triangle' (Atkinson 1999; Bredin 2008) and upon which much of the 'identity' of project management has been built (Atkinson 1999).

Critics of PMBoK® argue that these 'hard skills' do not completely explain the role of the modern project manager. For decades, project management researchers have been calling for more focus to be placed 'soft skills' in the teaching of project management (Berggren & Söderlund 2008; Narh 2013). These 'soft skills' can be thought of as the intangible 'people' management skills that practitioners utilize to manage the human elements of their projects (El-Sabaa 2001). 'Soft skills' include leadership, communication, emotional intelligence and problem-solving (Adams 2016; Usher 2019; Usher & Whitty 2017a). A range of these soft skills has been included in Table 2.

**Table 2: Project Management 'Soft Skills'**

Category	Soft Skill
Leadership	Creating project vision (Matinheikki et al. 2016)
	Building trust (Madsen 2015)
	Inspiring and Empowering teams (Shenhar 1999)
	Creating project team culture (Madsen 2015)
Emotional Intelligence	Discerning personal agendas (Knox et al. 2017)
	Managing expectations (Usher & Whitty 2017b)
	Managing interpersonal conflicts (Aga, Noorderhaven & Vallejo 2016)
	Empathy (Dulewicz & Higgs 2005)
Communication	Active Listening (Madsen 2015)
	Creating consensus (Matinheikki et al. 2017)
	Sense-making (Ang 2018; Weick, Sutcliffe & Obstfeld 2005)
	Storytelling (Johansson-Sköldberg, Woodilla & Çetinkaya 2013)
Problem-solving	Problem identification (Brown 2008)
	Scenario analysis (Bodwell & Chermack 2010)
	Assumption identification (Liedtka 2015)
	Collaborative ideation (Gaim & Wåhlin 2016)

Many authors believe that soft skills have been marginalized within project management training and education (Bourne & Walker 2004). Pant & Baroudi (2008) make the claim that, traditionally, the focus of project management education has "...been the hard skills deemed necessary for managing projects, relegating soft skills to the background..." (p.126).

This paper does not intend to enter the debate about the benefits of teaching hard/soft skills in project management education. However, it is important to understand that both skill types exist within the extant literature and that many believe that the practice of project management requires a combination of both 'hard skills' and 'soft skills' (Halstead 1999).

This distinction is important to our paper because, as authors such as Pant & Baroudi (2008) highlight, although it is feasible to conceive AI, ML and Bots taking on many of the routine tasks associated with project management 'hard skills', these technologies will not be in a position to replace human judgement and decision making at any time in the foreseeable future. From this we can deduce that the role of the project manager will survive the dawn of the 4th Industrial Revolution, however, it will have to concede ground in terms of the skills that have traditionally been considered fundamental to the profession. The inevitability of this concession raises a question regarding the pedagogical impacts that AI, ML and Bots will have on the current and future generations of project managers. This question is one that is considerably more urgent than many in the field of project management or education realise or are willing to admit (KPMG 2019).

### ***Pedagogical Impacts on Project Management***

Butler (2015) suggest that one of the major changes occurring in the profession of project management is a movement away from project managers who are technical experts (i.e. the 'hard skills'), towards practitioners who are problem-solvers and integrators. Usher (2019) agrees, arguing that the role of the modern project manager is best described as a 'systems specialist' who provides the structural, relational and cognitive frameworks necessary for managing complex adaptive systems rather than a purely 'technical' expert.

This transition from technical expert to system specialist is creating pedagogical challenges faster than many educational institutions can adapt. Thomas & Mengel (2008) state that the "...field of education is searching for ways to respond to the fast-approaching impact of artificial intelligence (AI) across all sectors and fields..." (p.304). In the midst of this rapid onset of change, it would be easy to get swept up in the growing capabilities of AI, ML and Bots and to falsely assume that these will result in the end of the project management profession (Feuillet 2019).

The current pedagogical model for project management in tertiary education has been described as too formulaic (Bell & Olomolaiye 2012), too linear (Thomas & Mengel 2008) and too wedded to traditional 'hard skills' (Adams 2016). If these criticisms are correct, then the current model may not bode well for students who are preparing to commence university in the field of project management. Especially when we consider that KPMG (2019) suggests that future project management professionals will not need expertise in the many of the traditional competencies (i.e. 'hard skills') of project management. Instead, project management professionals of the future will need to: (i) understand and interpret the data provided to them by AI, ML and Bots; (ii) use this information to solve problems and make recommendations; and perhaps most importantly, (iii) utilize this data to create and deliver human-centred project outcomes.

The concerns raised by other researchers regarding the current pedagogical model for project management, coupled with the rapid onset of AI, ML and Bots within the industry, and the assertion that future project management professionals will no longer require the 'hard skills' competencies traditionally taught in tertiary education programs, raises questions regarding the current and future validity of the project management education in Australian Universities. For years now academics have pondered the legitimacy of the inclusion of soft skills in the education of project management, it now appears, with the rise of AI, ML and Bots that this debate is now "...considerably more urgent, [and no longer] existential..." (KPMG, 2019. p.3).

## **RESEARCH QUESTION**

The literature presented in this paper indicates that project management education in Australian Universities focuses heavily on teaching the 'hard skills'. This focus raises some interesting questions, particularly when we consider the growing body of research and literature which indicates that AI, ML and Bots will predominantly impact on the traditional, 'hard skills' of project management (Alam et al. 2010; KPMG 2019; Levitt & Kunz 1987; Senthilkumar, Varghese & Chandran 2010). In this context, this research asks:

***Are Australian Universities preparing project management students for the impact that AI, ML and Bots will have on the profession?***

## **RESEARCH METHODOLOGY**

Mertens (2014) insists that the theoretical framework for any research project must be explicitly outlined at the commencement of the research, as it has "...implications for every decision made in the research process..." (p.3).

This paper adopts a constructivist ontology. We have approached the research from the perspective that reality is a pluralistic, social construct (Ang 2018). We have assumed that 'reality' is created by social actors who assign meaning to events.

Because this research is approached from the understanding that reality is a social construct, it follows that this research adopts an interpretivist epistemology. This epistemology assumes that we can only understand reality by exploring multiple, subjective accounts of a targeted phenomenon (Järvensivu & Törnroos 2010), and it is from these that we can gain a collective understanding of 'truth' (Onwuegbuzie 2002).

Milliken (2010) argues that qualitative methods provide the best methodological fit for research which adopts a constructivist ontology and an interpretivist epistemology. Hence, our research was designed using qualitative research methods.

The research presented in this paper explores the nexus of three different fields: (i) Education: a field in which there is an extensive amount of prior empirical research; (ii) Project Management: a field which has a growing body of empirical research available; and (iii) AI: a field which is in its infancy and has a relatively limited empirical research to draw on. At the intersection of these three fields, there is a paucity of empirical research available. Milliken (2010) has argued that the most appropriate qualitative research methodology for areas in which there is limited prior empirical research is Grounded Theory, therefore we have adopted this methodology.

## **RESEARCH DESIGN**

In order to answer our research question, we need to investigate two areas. Firstly, project management education offerings in Australian Universities. Secondly, the applications and speed of adoption of AI in the practice of project management. This dual focus requires two different research processes which can be synthesized into our findings and conclusion. These two research processes are outlined in this section of the paper.

To explore these areas, we synthesised a research framework from the 50 process tasks outlined in Table 1 and the 16 skills outlined in Table 2. This framework formed the basis of both coding categories and survey structure.

### ***Project Management education offerings in Australian Universities.***

Our research investigates what project management courses currently being offered in Australian Universities. Our aim is to understand:

- i. **The subjects offered in each course:** We anticipate that these findings will identify the blend of hard skills and soft skills being taught and which of the PMBoK ® knowledge areas the subjects in these courses align with. It hope this will assist us in drawing conclusions about which subjects might be impacted by the adoption of AI in project management practice.
- ii. **The duration of each course:** We anticipate that these findings will assist us in drawing conclusions regarding when AI capabilities need to be considered in the design of project management syllabi.

### ***Data Collection***

The data was collected through an internet search of Australian Universities offering project management courses. A total of 22 Universities around Australia were identified as offering project management courses at either an undergraduate or master's level. Using this sample, we collected data on course duration and undertook a review of the syllabus for each subject to determine what was being taught.

### ***Data Analysis***

The collected data were coded using the research framework established. This coding identified: (i) Which of the 10 project management knowledge areas, if any, the subject syllabi aligned with; (ii) Whether the subject taught a 'hard skill' or a 'soft skill'. We also included two additional categories: (iii) 'General' for overview, or non-specific project management subjects; and (iv) "Not PM" for subjects that did not align with any of the 10 project management knowledge areas.

Elective subjects were excluded from the analysis as the researchers could not determine which subjects' individual students might select.

### ***AI in the practice of project management***

This research delimits the range of reference for AI applications to the project management of facilities construction. This limitation is placed on the research, for two reasons. Firstly, construction projects in Australia mainly adopt the PMBoK ® methodology, which aligns with the methodology adopted in our research framework. Secondly, both researchers only have experience project management of facilities construction and did not feel qualified to draw conclusions from data which was outside their area of expertise.

With this understanding, our research investigates the application of AI/ML and Bots in project management. Our aim is to understand:

- i. Which of the 50 project management processes AI/ML and Bots may have the potential to impact? and
- ii. What is the anticipated timeframe for these applications to become 'common-place'?

### ***Data Collection***

Our research is undertaken using a purposive sample. An approach which is not uncommon in Grounded Theory research (Charmaz 2017). The sample group is a combination of; (i) Project management educators who are currently delivering project management courses at Australian Universities ('Educators'); (ii) Individuals who are developing AI applications for project management of construction projects ('Developers'); and (iii) Project management practitioners ('Practitioners'). The educators were identified through their University websites 'staff listing' and the developers and practitioners were identified through LinkedIn and industry networks. A total of 52 survey invitations were issued across the sample group and 20 survey responses were received.



Data was collected through an online, structured survey. The survey presented the 50 PMBoK® processes ('hard skills') grouped according to the Process Groups outlined in PMBoK, these being: Initiating, Planning, Executing, Monitoring and Controlling, and Closing. In addition, the survey presented 16 soft skills grouped 4 categories, being: Project Leadership, Emotional Intelligence, Communication and Problem-solving.

This survey utilized a five-point Likert timescale (1 year, 3 years, 5 years, 10 years, Never and Unsure) and asked Educators, Developers, and Practitioners to forecast when the use of AI would become 'common-place' for project management practitioners in each of the 50 process areas and 16 soft skills areas. Respondents were also asked to provide demographic information regarding their years of experience in their field, their level of education and how strongly they agreed/disagreed that they understood the potential impacts of AI on the practice of project management. Finally, the respondents were asked to rate, on a five-point Likert scale ranging from 'totally unprepared' to 'world-class and cutting edge', how ready they believed Australian Universities are for the impacts of the 4<sup>th</sup> Industrial Revolution in the education of project managers.

### ***Data Analysis***

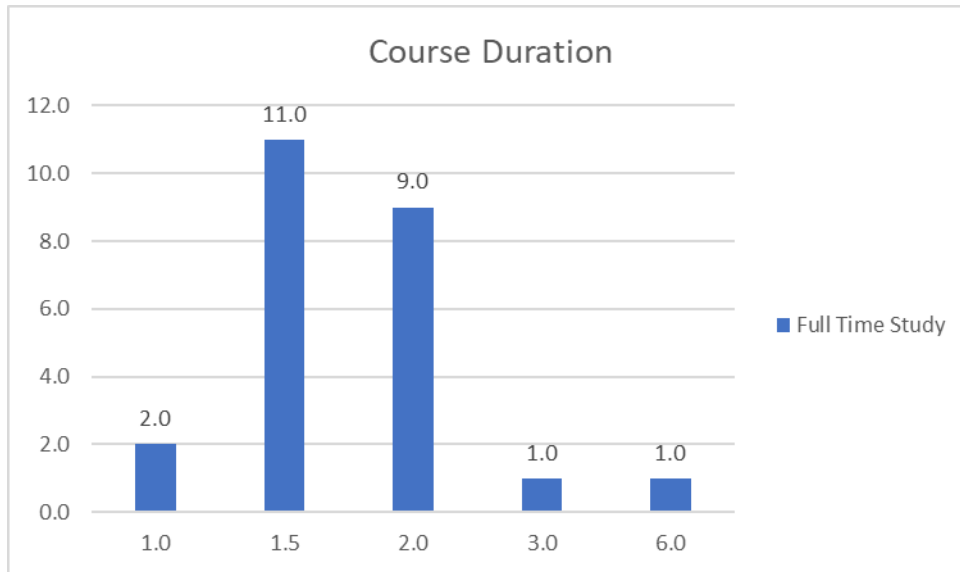
The survey data were aggregated into the three groups identified the sample. Educators, Developers, and Practitioners. The responses were tabulated and the mean result of the individual groups across the five points on the Likert scales was established for each of the survey questions. A comparative analysis of each group was undertaken to identify trends in the data, including any commonalities or differences between the groups within the body of the survey results.

### **RESULTS**

We will now present our results.

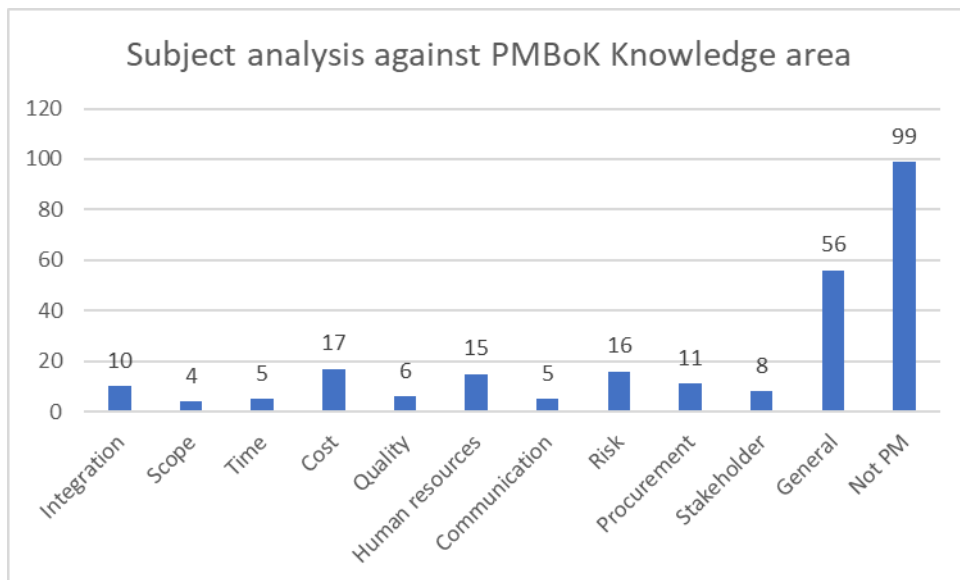
#### ***Project Management education offerings in Australian Universities.***

Our research identified 24 project management courses available from Australian Universities. 22 of these were master level courses and 2 of these were undergraduate courses. Within the 24 courses offered, there were 268 individual subjects identified. 16 elective courses were excluded from the analysis process, leaving a sample size of 252 (n=252) subjects offered in project management courses. The data showed that assuming a full-time course load, the majority of the project management courses offered at Australian Universities are 1.5 year in duration (46%), with 83% of courses falling into either the 1.5 to 2.0-year duration (Refer Fig 1). The 6-year course is a double degree in Construction and Project Management.



**Figure 1: Project Management Course Durations**

The 252 subjects were also categorised against the 10 PMBoK® knowledge areas. Additional categories of “General” as well as “Not PM” were also used in the assessment. Our data indicates the top five categories offered are: 1. Not PM (99 subjects); 2. General (56 subjects); 3. Cost (17 subjects); 4. Risk (16 subjects); and 5. Human Resources (15 subjects). The breakdown of all the subjects against the categories is provided in Fig 2.



**Figure 2: Project Management subjects offered by Australian Universities by PMBoK knowledge area.**

Our results show that 39% of the subjects offered in project management courses in Australia are not actually related to any of the 10 project management knowledge areas outlined in PMBoK ® (Fig 3).

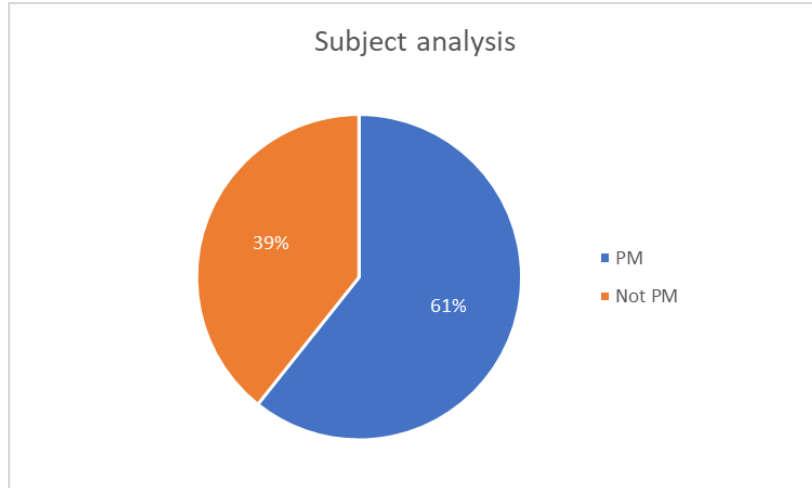


Figure 3: Subject split (PM vs Not PM)

Examples of subjects that the researchers coded as not aligning with any of the 10 PMBoK ® knowledge areas are presented in Table 3.

Table 3: Subjects not aligning with PMBOK knowledge areas

*Non-project management subjects offered*

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Enterprise Transformation and Innovation	Business Modelling and Analysis
Introduction to Climate Change in Business	Marketing Management
Built Environment Law and Ethics	Entrepreneurship, Innovation and Creativity
Materials Science	Methods of sustainable development
Digital Built Environment	Asset management in an Engineering Environment
Evidence-Based Management	Decision Support Tools
Technology Essentials for Managers	Urban and Regional Planning Theory

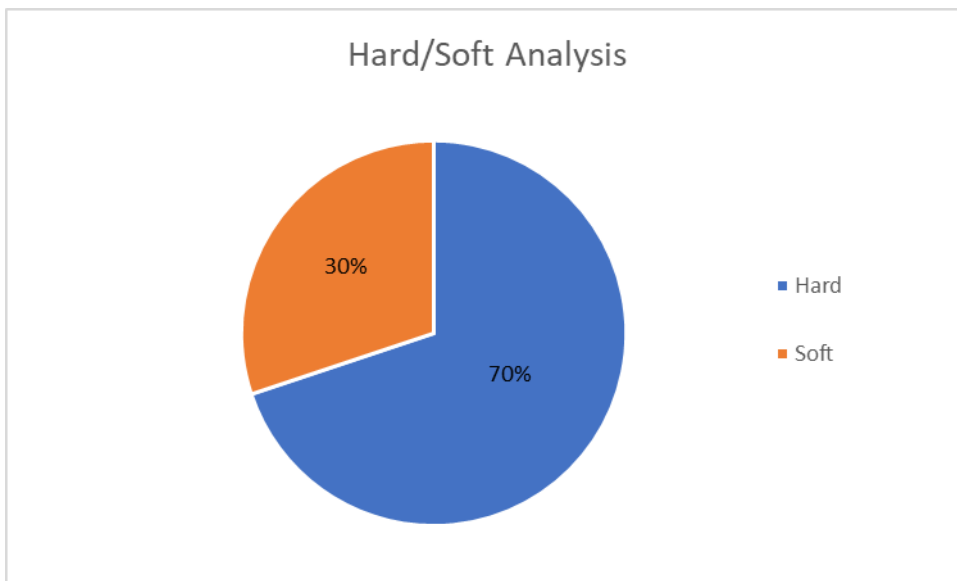
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Furthermore, 21.8% of the subjects offered in these courses were categorised by the researchers as “General” project management and not specifically related to any of the 10 PMBoK® knowledge areas in particular. Examples of subjects that the researchers coded as “General” are presented in Table 4.

**Table 4: Examples of 'General' Project Management subjects offered in Australian University Project Management Courses**

<i>Subjects offered</i>	
Project Management Essentials 1	Project Management Fundamentals
Project Management Essentials 2	Portfolios and Programs Management
Projects and Performance	Complex Project Management
Managing the Project	Applied Project Management
Principles of Project Management	Project Delivery Approaches
Applications of Project Management	Construction Project Management Principles
Program Management	Fundamentals of project Management

The final analysis in this phase of the research was to review all the subjects coded as one of the 10 PMBoK® knowledge areas (i.e. excluding 'General' or 'Not PM') and to categorise these as either a 'hard skill' or 'soft skill'. The syllabi of all 15 "Human Resources" subjects were reviewed in detail to determine whether their primary focus was on the scheduling of human resources as a finite commodity (hard skill) or on the management of the people in the teams (soft skill). Our data indicates that 70% of the subjects offered can be categorised as hard skills (Fig 4).



**Figure 2: Subjects offered categorised as either hard or soft skill**

***AI in the practice of project management***

Our survey data highlighted a difference of opinion regarding the rate of adoption of AI, ML and Bots into the Australian project management industry. The Developers believed that AI, ML and Bots would replace 99.07% of tasks associated with 'hard skills' within the next 5 years. However, both the Educators and Practitioners shared a more tempered view of adoption into the industry. The Educators believing that only 60% of the hard skills

would be replaced within 5 years, and the Practitioners believing that only 49% of the hard skills will be replaced by AI, ML or Bots in the next five years.

At the other end of the adoption timeline, the Developers believed that 100% of the hard skill based project management tasks would be replaced by AI, ML and Bots within 10 years. The Educators and Practitioners disagreed, with 17.53% and 23.24% respectively of these groups believing that some hard skills will never be replaced by AI, ML and Bots (Fig 5).

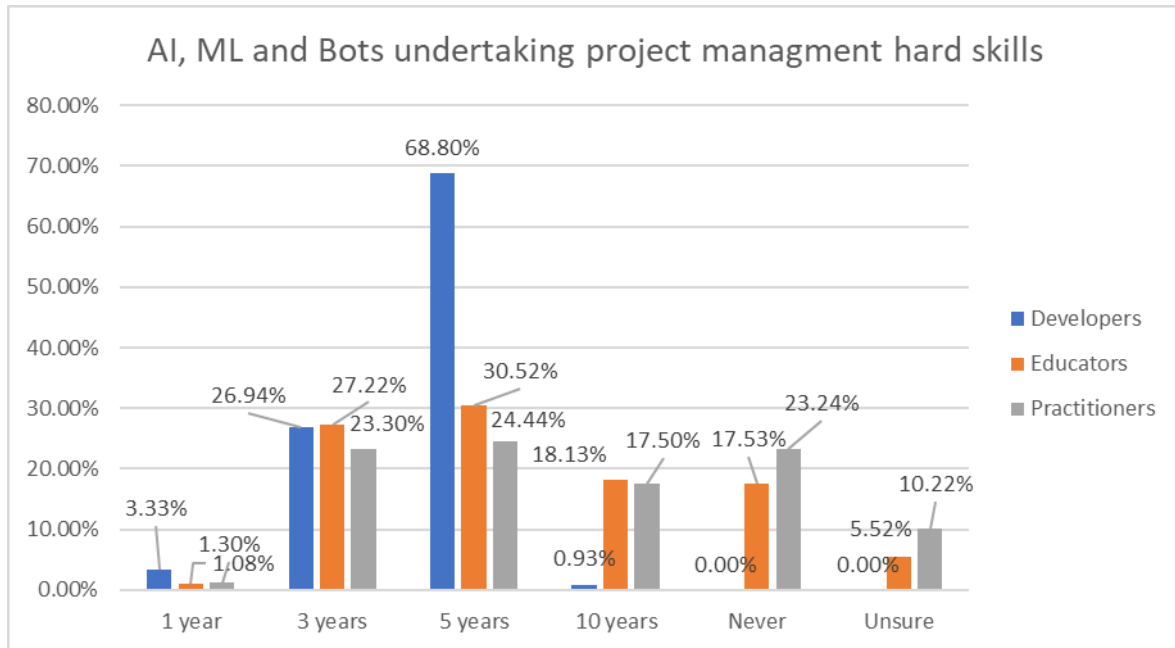


Figure 3: Estimated speed of AI, ML and Bots taking on project management hard skills, by sample group

There was more agreement between the three groups when they were asked to forecast on when AI, ML and Bots might be able to undertake the soft skills associated with project management. All three groups agreed that AI, ML and Bots would not make any major in-roads into the soft skills of project management within the next 1-3 years. By year 5 all the groups agreed there would be some infiltration of AI, ML and Bots into the project management soft skills. Developers and Practitioners believing 25% of the soft skills outlined in the survey could be done by AI, ML or Bots within 5 years, and Educators believing this would be closer to 36%. After the 5-year mark, the Educators and Practitioners are closely aligned believing that between 43.75% and 47.92% of the soft skills can never be replaced by AI, ML or Bots. However, the Developers were more optimistic believing that 79.17% of the soft skills will be replaced by AI, ML and Bots within the next ten years (Fig 6).

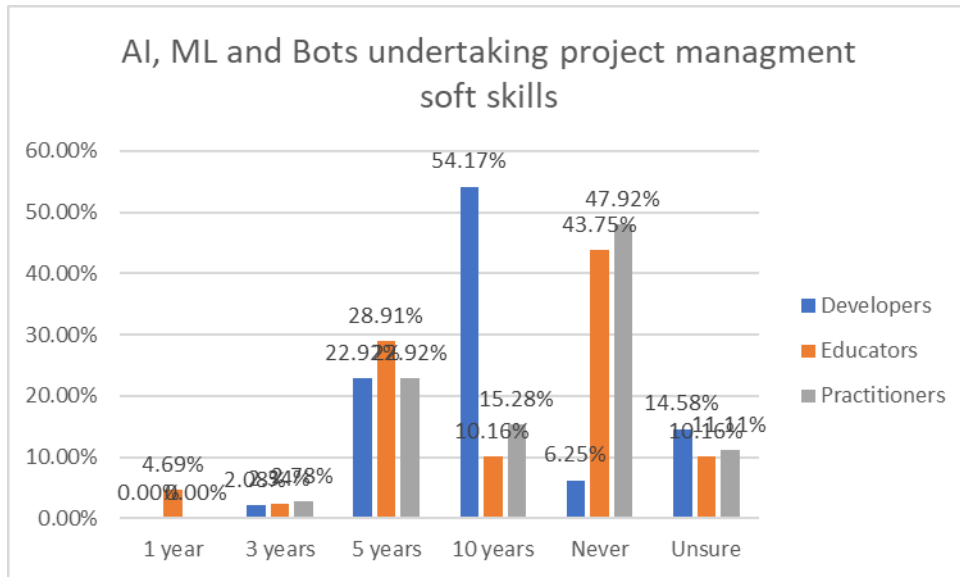
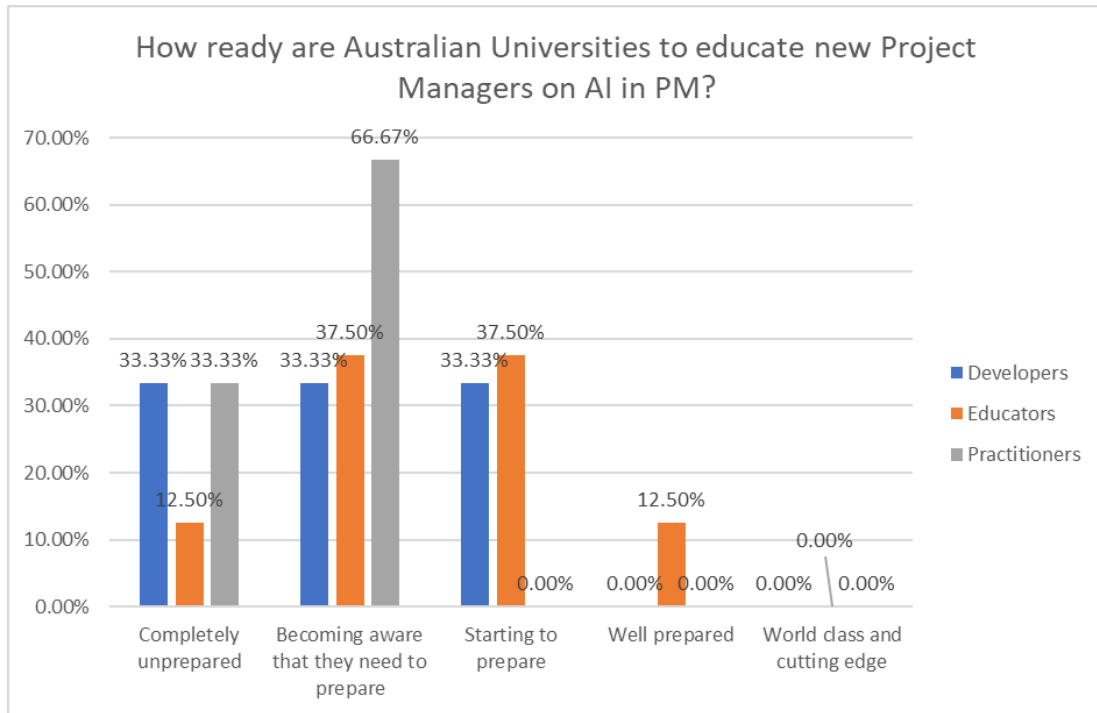


Figure 4: Estimated speed of AI, ML and Bots taking on project management soft skills, by sample group

**Australian Universities readiness to educate project managers for AI, ML and bots**

Respondents were also asked to determine how ready they felt Australian Universities are to educate project managers in the impacts of AI, ML and Bots so that the students were 'job-ready'. The results show considerable variances between the three groups. Most of the responses indicated that Australian Universities were, at best, starting to prepare. All of the Practitioners believed Australian Universities were, at best, 'becoming aware that they needed to prepare'. 33.33% of the Developers believed the Universities 'starting to prepare', while 12.5% of Educators felt that Australian Universities were 'well prepared'. None of the groups felt that Australian Universities were 'World Class and Cutting Edge' (Fig 7).



**Figure 5: Australian Universities preparedness to produced job-ready project managers in the age of AI and ML.**

**FINDINGS**

We will now discuss our findings in relation to the research question: *Are Australian Universities preparing project management students for the impact that AI, ML and Bots will have on the profession*

**Project Management education offerings in Australian Universities.**

Our data indicates that Australian Universities cater predominantly to postgraduate students, with 91.6% of project management courses being offered at a master’s level. We were initially surprised to find that 61.5% of the subjects offered in these courses fell into either the ‘General’ or ‘Not PM’ categories. We postulate that this may be a result of the courses targeting postgraduate students, who may have already gained a level of project management competency prior to enrolling. However, if this were the rationale, we would have also expected these courses to offer more ‘advanced’ project management skills and techniques rather than ‘General’, or ‘Not PM’ skills. Another possible reason for the high number of ‘General’ or ‘Not PM’ ratings in master’s course could be linked to the paucity of undergraduate project management courses. We felt this could indicate that students enrolling in these project management courses are entering from non-project management backgrounds and are using the master level offerings to augment their existing technical backgrounds, thus requiring them to gain a more foundational understanding of project management despite the master level course. We felt this made the high number of ‘General’ or ‘Not PM’ ratings understandable.

Our data indicate that 83% of the courses offered are either 1.5- or 2.0-years duration (based on full-time study). This information provides us with a window of time that we can overlay over the results in the AI section regarding the rate of adoption. As 46% of the courses are 1.5 years in duration, we have adopted this as the average (modal) ‘cycle-time’ for students to move through a full project management course.

### ***AI in the practice of project management***

Our data indicate that Developers were more aggressive in their attitude towards the adoption of AI, ML and Bots into project management, than either the Educators or the Practitioners. 99.07% of the Developers believed that AI, ML and Bots would replace all of the project management 'hard skills' within the next five years. The Educators and Practitioner take a more tempered view, with the Educators believing that only 60%, and the Practitioner's believing that only 49%, of the 'hard skills' will be undertaken by AI, ML and Bots within the next 5 years. Differences of opinion regarding the actual rate of adoption aside, our data is clear that all three groups believe that a significant portion (a mean adoption of 69.67%) of the traditional project management 'hard skills' will be impacted or replaced by some form of AI, ML or Bots within the next five years.

The data from the other end of our timescale (i.e. the 10-year window) also indicates a difference of opinions between the three groups. At the 10-year mark, the Developers are anticipating that all the 'hard-skills' based project management tasks will be undertaken by AI, ML or Bots. This is in contrast with the Educators and Practitioners who believe that 82.47% and 76.76% (respectively) of 'hard skill' based project management tasks will be replaced by AI, ML or Bots over this same period. However, once again, we felt the most significant finding was not the differences but that all of the groups in the sample believed that at least three-quarters of the traditional project management 'hard-skill' tasks would be impacted or replaced by AI, ML or Bots within the next decade.

With reference to the 'soft skills' outlined in our survey, the Educators and Practitioners were closely aligned in their belief that AI, ML and Bots will never be able to replace a portion of these tasks (43.75% - 47.92% respectively). This is markedly different to the Developers who believed that 79% of the 'soft skills' identified in our survey could be impacted or replaced by some form of AI, ML or Bots within the next ten years. However, all groups believe that at least 25% of 'soft skill' based tasks will be impacted or replaced by AI, ML or Bots within the next five years.

Our results indicate that a significant shift will be required in project management educational offerings. If we consider that 70% of the current subject offerings are based on 'hard skills', which all three groups agree have a 69.96% chance of being impacted or replaced by within five years, and that the groups agree that at least 25% of the 'soft skill' based tasks will be impacted in the same time frame this means that, at best, Australian Universities have 3 course cycles (4.5 years) to undertake a significant change to their project management curricula.

### ***Australian Universities readiness to educate project managers for AI, ML and Bots***

Turning to the question of how ready Australian Universities to produce job-ready project managers, we see the Educators taking a more optimistic view than either the Developers or the Practitioners. At the lowest level of preparedness ('Completely unprepared') only 12.5% of Educators felt this was the case. However, the Developers and Practitioners rated this level higher, with 33% of both groups agreeing that Australian Universities were 'Completely unprepared' for the impacts of AI, ML and Bots on the field of project management.

We found it interesting that it was the Practitioners who felt Australian Universities were the least prepared, with 100% of this group believing that Australian Universities had not even reached the mid-range rating of 'Starting to prepare'. The Developers and Educators both returned similar responses at this mid-range rating (33.33% and 37.5% respectively). We postulate that the agreement between these two groups indicates that Australian Universities are in fact starting to prepare, but that many of the Practitioners are not aware of the development that Universities are undertaking this space because they have not yet been applied to the course curricula.

We found it interesting that it was only the Educators who rated Australian Universities higher than a mid-range rating. This indicates a disconnect between the Educators and the other two groups in the sample. Finally, it is telling that none of the groups in the sample believed Australian Universities were either 'cutting-edge' or 'world-class' in their educational offerings in this space.



## **CONCLUSION**

Our research asked:

***Are Australian Universities preparing project management students for the impact that AI, ML and Bots will have on the profession?***

From our research, we conclude that the field of project management will see AI, ML and Bots having a significant impact on both 'hard skill' and 'soft skill' based tasks and processes within the next five years. Further to this, we conclude that a major shift in the field project management education will occur within the next ten years, with greater than 76.76% of 'hard skills' and 52.08% of 'soft skills' being undertaken by AI, ML or Bots. We also conclude that Australian Universities are not well prepared for these changes.

Added to this, we conclude that the rate of adoption indicated by our results means that these educational institutions have, at best, 3 teaching cycles to make the necessary changes. Furthermore, we believe, based on the rate of adoption indicated by our results, that once these changes commence there will be a need to continually update these educational offerings for at least the following five years as the impact of AI, ML and Bots continues to grow in the field of project management.

Based on our results we conclude that, at the present time, Australian Universities ***are preparing*** project management students for the impact that AI, ML and Bots will have on the profession. However, we also believe that this could change rapidly. Thus, we argue that, unless Australian Universities have incorporated AI, ML and Bots into their course offerings within 3 teaching cycles (i.e. 4.5 years) they run the risk of no longer preparing their students for their profession.

## **LIMITATIONS OF RESEARCH**

The research presented in this paper has several limitations. The research utilized a survey with a small sample (n=20). This sample size is sufficient to create the necessary datasets and extract findings for a targeted study such as the one outlined in this paper. However, the sample size does limit the generalizability of the findings.

A further limitation to the generalizability of our findings arises from the fact that technologies such as AI, ML and Bots are relatively new and constantly evolving. For this reason, it is conceivable that the technologies anticipated in this research may change considerably over the time periods outlined in our research. This may significantly impact our conclusions.

Finally, our research focused on construction project management, a PMBoK ® based framework and the Australian project management industry. The authors conceded that results from other project management sectors (e.g. ICT and the Computer Sciences) may produce markedly different results. Researchers and practitioners should take these limitations into consideration when applying any of our findings or conclusions.

## **IMPLICATIONS FOR RESEARCH AND PRACTICE**

Our research offers several implications for project management research and practice.

### ***Research***

In terms of research implications, there is the opportunity to adopt our design and methodology to undertake research outside Australia. Undertaking similar research in other countries will remove any cultural biases inherent in our research. In addition, researchers could undertake similar research with a larger sample. This would serve to test the reliability and generalizability of our findings.

Additional research could be undertaken into the differences of opinion between the three groups in our sample (Developers, Educators and Practitioners). Investigations into why these three groups differ significantly on some of their responses could provide further insight and uncover if there are any disconnects in understandings or definitions.

### ***Practitioners***

In terms of practical implications, our research indicates that AI, ML and Bots are poised to have significant impacts on the profession within the next five years. Our research also indicates that Practitioners may not be able to turn exclusively to Australian Universities to provide the necessary education to make them job-ready within 3 teaching cycles.

The implication for Practitioners is that ignoring the impacts of AI, ML and Bots on their profession is no longer an option. AI, ML and Bots will begin impacting the way project management is 'done' within 5 years. Therefore, it is incumbent on Practitioners to undertake their own on-the-job training and education in order to become job-ready and remain relevant in a rapidly changing profession.

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