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Improving design management

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Abstract

This study report highlights independent design managers (IDMs) in the New Zealand construction industry.

Unlike other construction disciplines, no minimum qualifications or professional memberships for IDM professionals exist in New Zealand. Consequently, IDMs may fulfil their role without necessarily having educational or professional competency in any design discipline. Anecdotal reports indicate variable design competency and that construction procurement practices may undermine design outcomes. IDMs may have problems ensuring the design team achieves client design objectives.

This study details how industry stakeholders perceive this issue and consequently whether there is a need to establish a best-practice guide and new qualifications for IDMs.

Keywords

Design management, project management, design, building, construction, quality.

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Executive summary

Independent design management is a growing profession. An independent design manager (IDM) acts for the client to oversee and coordinate the activities of design professionals. Historically, independent design management was executed by the project architect. As construction complexity has grown, IDMs have evolved as specialists who clients employ alongside the lead design consultant and broader design team (Male et al., 2007). This study reports industry views on how IDMs can best function to ensure added value. It details industry opinion on fundamental competencies and whether IDMs are currently displaying the proficiency expected. The report also presents industry views on how different procurement and contracting methods influence design outcomes.

IDM systemic issues

Design-related outcomes are often beyond the control of IDMs. Contractual settings of construction projects are not always supportive of design integration. Design-bid-build often sees the built form being negatively affected by limiting early contractor input. Views diverged on why, with some survey respondents stating that it is because this method of procurement typically ties design outcomes as represented in the final built form to the fixed price of the contractor. Fundamentally, fees are not sufficient in traditional contracts to ensure comprehensive design. Other respondents, however, felt that traditional forms of contract that clearly delineate the project scopes of designers and constructors often rely too heavily on IDMs, who might not have a solid grounding in the technical design disciplines involved.

IDMs not meeting performance expectations

All the study's participants agreed that many IDMs are not meeting sector performance expectations. Several reasons for this were suggested:

- Currently, there is no universally understood delineation between and definition of the respective responsibilities of the IDM and the lead design consultant. This creates confusion and becomes a performance issue for the entire project team (designers and builders) owing to confusion about lines of reporting and accountability. A clearer definition of the IDM role would help to address this.
- Guidance for IDMs was deemed necessary to ensure design integration and quality.
- Concern was expressed how consultancy firms employ young and inexperienced people into IDM roles to extract maximum financial value from their labour. The use of inexperienced professionals, badly stretched across multiple projects, flies in the face of industry expectations and inevitably diminishes design quality. Many felt the commercial model that DM firms currently operate needs to be re-evaluated.
- Procurement method was also identified as curtailing IDM effectiveness, which suggests that some issues associated with sector performance are related to factors that extend beyond the capabilities of design management professionals alone. Intervention to raise performance standards.

It is apparent that a sector-wide IDM competency framework and education is critical to future improvement of the design management profession. An enhanced understanding of the impact of commercial practices on design quality is also needed. Suggestions for improvement offered by the study's participants include a mixture of:

- tertiary courses tailored specifically to learning skills associated with design management
- professional development opportunities for people who already have industry experience in another area
- voluntary accreditation.

Quick wins for the design management sector could be found by selecting procurement methodologies that enable enhanced design integration. Design-build was largely considered to be the best procurement model because it enables integration between project stakeholders. It is recommended that the design-build procurement method be promoted to clients although it may not be suitable for every construction project.

Competencies needed to meet performance expectations

Study participants identified a broad suite of competencies for quality service delivery. The two most prominent areas of IDM underperformance identified were managing the budget process and ensuring integration between design disciplines. Soft skills and behaviours were also heavily emphasised, including:

- ability to communicate effectively with design, construction and commercial stakeholders
- design empathy – ability to understand diverse views
- a professional mindset with ethical standards and project management capability.

There was no common agreement among the study participants as to the best background for IDMs to come from. While experience in architecture, engineering, construction and other professions was identified as being valuable for IDM professionals, there was general agreement that extensive industry experience is a main indicator of capability.

Overarching recommendations

1. **Define the role of the IDM and create a framework for best practice:** Explicitly define the role of the IDM within the New Zealand Construction Industry Council Guidelines and collect examples to establish a framework of best practice.
2. **Develop an educational framework for IDMs to benchmark performance and communicate best practice:** A formal investigation is needed to explore how principles of concurrent engineering could be adopted to advance the development of an educational framework for IDMs in New Zealand. This investigation could also assess whether the Design Quality Indicator (DQI) system (Page & Gordon, 2017) could be formalised and utilised as a competency framework for IDMs.
3. **Develop new qualifications for future IDM professionals:** In the short term, micro-credentials in the IDM discipline could be developed to supplement existing qualifications in related disciplines such as architecture, engineering and construction trades. In the longer term, stand-alone qualifications could be developed at postgraduate level to provide the necessary skills.
4. **Educate clients on how procurement methods can affect design outcomes:** The study has shown that procurement methods demarcate boundaries between design consultants, contractors and project stakeholders. The best solution would be to provide guidance on procurement methodology and forms of contract that enable effective design outcomes. Ideally, this would be an easy-to-access resource detailing benefits and risks of procurement options.

1. Introduction

1.1 Independent design management in New Zealand

Independent design management is a growing profession. An independent design manager (IDM) acts for the client to oversee and coordinate the activities of design professionals. Historically, independent design management was executed by the project architect. As construction complexity has grown, IDMs have evolved as specialists who clients employ alongside the lead design consultant and broader design team (Male et al., 2007), although architects or engineers are still able to fulfil this function.

However, owing to the growing technical complexity of modern projects and the now commonplace complicated nexus of contractual relationships, design management has become a specialist discipline that clients can now choose to procure outside of the lead design consultant and broader design team.

Splitting the functions of managing the design process and the actual undertaking of design, in theory, allows architects and engineers to focus on their core design competencies without being overly distracted by contract administration. However, as design and design management functions are disaggregated, new risks may emerge. Unlike design-led professions such as engineering and architecture, no minimum qualifications or professional accreditation for IDMs exist in New Zealand. Potentially, this may open construction projects to increased risk and critical design failures.

1.2 Purpose

This study gauges industry perception of the need to raise performance standards amongst IDMs. The work identifies issues undermining IDMs' ability to manage the project design process, leading to problems with build quality.

This study reports industry views on how IDMs can best function to ensure added value. It details industry opinion on fundamental competencies of IDMs and whether IDMs are currently displaying the proficiency expected. The report also presents industry views on how different procurement and contracting methods influence design outcomes.

1.3 Research questions

The study addresses four questions:

- What design-related competencies do industry professionals deem to be fundamental to the IDM role?
- Do industry professionals believe IDMs display proficiency and fundamental competency?
- How does industry's contractual environment influence design management outcomes?
- What interventions are required to ensure IDMs consistently offer value to building and construction projects?

1.4 Method

The subject matter for the research is complex. The role of the design manager – specifically the IDM – sits at the nexus between construction, design, project management and leadership functions. As such it was decided to utilise a triangulation strategy to investigate quantitative (breadth of investigation) and qualitative (depth of explanation) aspects of the issue. The study used five principal research techniques to establish a comprehensive view of the role and competencies of IDMs in construction.

Table 1. Principal research techniques used in this study.

Technique	Commentary
Literature review	Objective: To create an international best-practice framework for IDMs.
Stakeholder interviews	Objective: To establish current opinion on IDMs, competencies, any need for improvement in competencies, perceived need for clarity in competencies, recognised qualifications and standards in the industry. • 18 recorded interviews with industry professionals spanning architecture, engineering, project management and design management disciplines. • Recorded January to April 2021. • Interviews were transcribed and assessed using thematic analysis.
Online survey	Objective: to investigate IDM competency. • 540 respondents from throughout New Zealand. • Targeted groups were those who interact with IDMs and project managers. • Conducted June to July 2021.
Focus groups	Objective: to further investigate the relationship between IDMs and construction quality. • Two five-person focus groups. • Conducted March to April 2022.
Expert review panel	Objectives: to verify the findings obtained and develop solutions for issues associated with the IDM role. • Review panel of six highly experienced executive leaders representing leading professional practices. • Conducted online on 13 May 2022.

2. Literature review

2.1 Concepts and practice

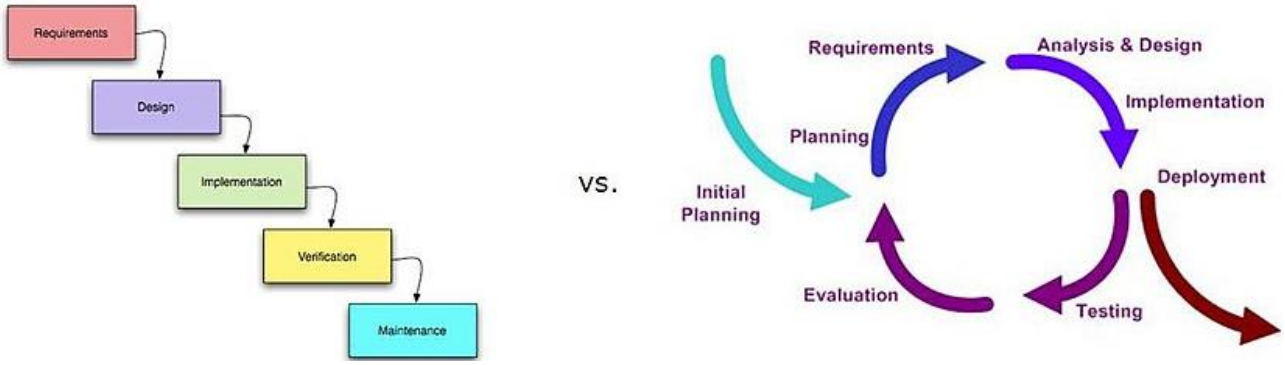
Independent design management is an evolving profession with complexity rooted in construction functions, forms, structures, procurement and financial strategies. In effect, independent design management is an "operational adhocracy" where designs situationally evolve. The master builder – the architect overviewing design and delivery of construction – is a declining presence. The UK Chartered Institute of Building (CIOB) formally recognised the IDM in the building process as far back as 2007 (Emmitt, 2010). Timelines are shorter, with bespoke procurement routes increasingly common (Tzortzopoulos & Cooper, 2007). This appears central to the problems in design management and integration seen in the industry today, hence the need to formalise training strategy (Andersen et al., 2005). Other professionals develop specific individual skills. For example, civil engineers are taught engineering design of structures, architects are taught aesthetic design, commercial architectural practice and project management in their professionally accredited degrees and other construction professions have different expectations. As there is no commonly accepted language of competencies for these professions, it is worthwhile to review the competencies for key professional bodies:

- New Zealand Registered Architects Board.[1]
- Royal Institute of British Architects.[2]
- Royal Institution of Chartered Surveyors.[3]
- International Project Management Association.[4]
- Engineering New Zealand.[5]

The review found competencies are framed using terms such as understand, execute or demonstrate – *doing the job rather than achieving* outcomes. Best-practice tools or effectiveness are minimised. Practically no consensus around skills exists among professionals.

The need to collaboratively develop solutions for more effective integrative design is a long-standing issue (Bølviken et al., 2010), leading to concepts such as concurrent engineering, which the parallelisation of tasks using integrated product development teams to evolve design. The concurrent engineering approach to design management recognises the need for all elements required in the delivery of a complex project to be incorporated simultaneously into rapid design development, optimisation, prototypes and production models (Figure 1). The effectiveness of concurrent engineering for construction optimisation has been noted (Anumba et al., 1999). Currently, defect errors arise from a disconnect between professional custom and practice. Integrative ideas have been gaining significant traction such as Last Planner (Ballard, 2000), which appears to be boosting design management competency.

[1] https://www.rabcpd.org.nz/guide/units-of-competency-standards-1050.htm
[2] https://www.dezeen.com/2020/09/01/riba-architects-mandatory-competency-tests/
[3] https://www.rics.org/globalassets/rics-website/media/qualify/pathway-guides/pathway-guides-requirements-and-competencies-v1.3-oct-2018.pdf
[4] https://www.pmi.org/learning/library/project-management-competencies-define-assess-plan-5925
[5] https://d2rjvl4n5h2b61.cloudfront.net/media/documents/Emerging_Professional_Development_Programme.pdf

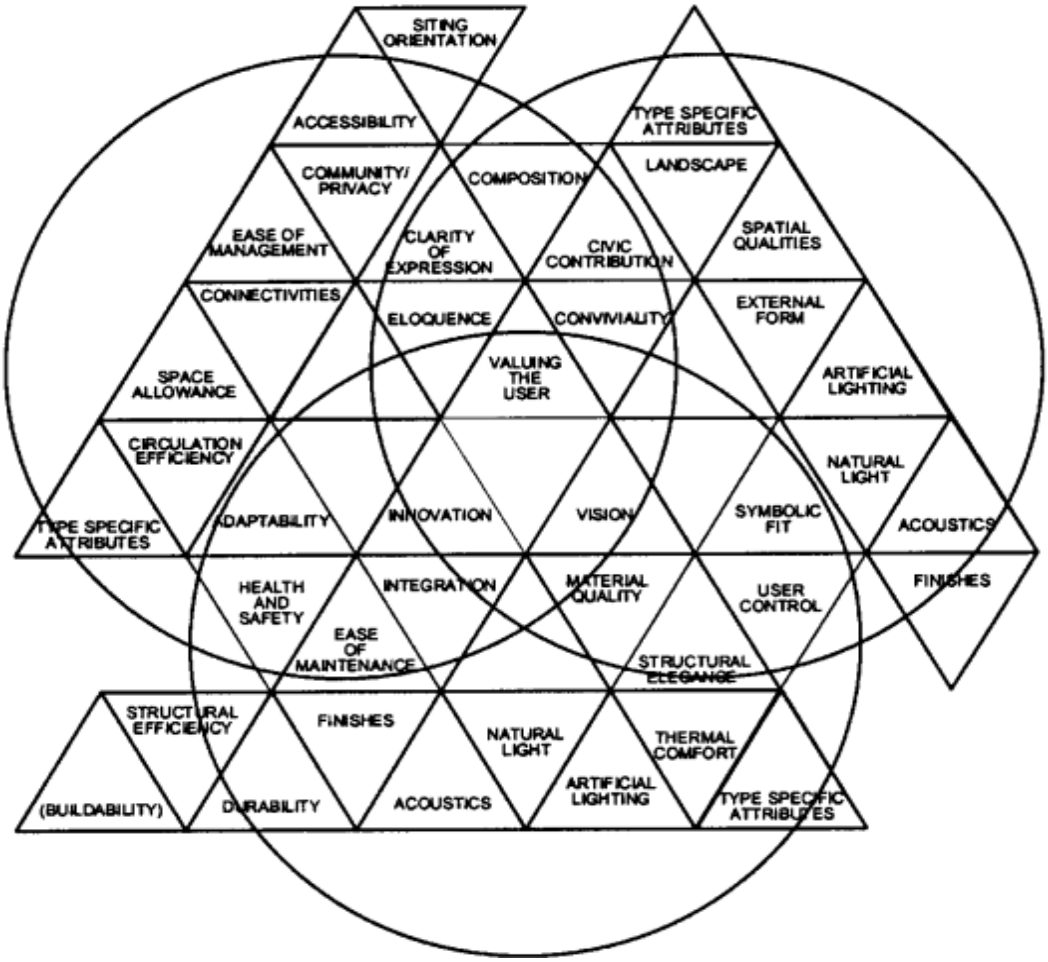


Source: Mdkoch84, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=5802627

Figure 1. Traditional versus concurrent engineering development processes.

2.2 Quality and defects

Design quality incorporates qualitative and quantitative aspects addressing construction rework (Gann et al., 2003; Fayek et al., 2004). Design quality can also relate to lack of design standards and incomplete drawings (Alarcon & Mardones, 1998). Design quality in construction is ambiguous. Consequently, evaluation of design is problematic. This highlights the need for common linguistic or descriptive frameworks for construction design quality (Figure 2).



Source: Gann et al., 2003, p. 326.

Figure 2. Conceptual framework showing overlapping nature design quality aspects.

The Design Quality Indicator (DQI) system (Page & Gordon, 2017) assesses building functionality, build quality and impact and identifies the priorities of stakeholders (clients, designers, contractors, etc.) through expert facilitation. DQI could potentially be a formative competency framework for design management. Design has an impact on building fitness (quality), and errors and lack of design management create multiple layers of error. Jingmond and Ågren (2014) identified development of defects in construction from sources to consequences, including:

- lack of knowledge
- inefficient communication of ideas
- commercial constraints and behaviours.

Defects found during occupancy are unaccounted for by designers and developers (Chong & Low, 2005), with 50% related to design management (Whang et al., 2017).

2.3 Skills and competencies

2.3.1 Information and communication

Construction involves basic engineering of forces, movements, loads and structures. The process of delivery is much more complex, involving different skills, professionals and philosophies. Communication and information management is central to construction. A significant issue in construction design management is a lack of a common language across architecture, engineering and construction (Talebi et al., 2020), which means identification of tolerance information on drawings can be compromised. By contrast, mechanical engineering uses geometric dimensioning and tolerancing as a language to communicate perfect detailing.

In one study, 50% of contractors reported insurmountable miscommunication design problems, and only 10% reported no problems (O'Connor & Koo, 2020). The same study found that 50% of change orders can be attributed to defective design, design omissions accounted for almost 38% of rework and design errors exceeded 14% of construction cost. Importantly, the study found that most losses result from communication failures during design development, a finding consistent with that of Aslam et al. (2019). Key design-based root causes included:

- scope and/or design changes
- poor documentation
- incomplete information
- improper planning
- software error
- designer qualifications.

Systematic, regularised communication patterns are needed for effective design management. Extending current thinking around Last Planner (Ballard, 2000) from simply scheduling into design optimisation may offer significant potential to reducing design problems.

2.3.2 Early involvement

Standard design practice revolves around specification and peri-contract design development work, subsequently incorporated into the final design development process. It has been long recognised that this process contributes to delays, cost increases and quality defects.

Under current practices, the IDM operates as technological gatekeeper, controlling information and so potentially causing a communication logjam, which then results in costly surprises later.

Significant benefits accrue from the inclusion of the key capabilities and knowledge needed for a construction project at any stage (Rahman & Alhassan, 2012). Sødal et al. (2014) note that the benefits of early contractor involvement include:

- improved constructability
- design and construction knowledge
- better product information
- improved cost estimation
- better profitability and feasibility analyses
- improved risk management
- better communication/collaboration
- better construction planning
- reduced errors.

Unfortunately, end users and facilities managers are overlooked during design, but this problem can be resolved by using early contractor involvement in cases such as public-private partnership (PPP) contracts (Botha & Scheepbouwer, 2015). Early contractor involvement can significantly facilitate design integration (Zerjav et al., 2013) so design managers need to ensure contractors and designers are party to early critical decisions and initial design iterations.

2.3.3 Coordination/integration

Integration and coordination are critical to success. Whang et al. (2017), building on the work of many authors, identified 40 factors that have a significant impact on the effectiveness the design management process:

- Project documents review.
- Similar projects case study.
- Terms and agreement review.
- Proposal of value engineering.
- Legal factors review.
- Create project management information system.
- Design review against project budget.
- Study of adequacy of structural grid planning.
- Building framework master schedule.
- Interface management for standards.
- Standardisation of different types of drawings and documents.
- Establish shop drawing master schedule by subcontractors and suppliers.
- Delivery control plan for international supply chain.
- Organisation of integrated design management team on site.
- Manage building code versus international code interface.
- Site conditions analysis.
- Site situation feedback.
- Design site checklist.
- Application of building information modelling (BIM).
- Impact analysis on surrounding buildings.
- Regular detail design meetings with international subcontractors and suppliers.
- Work cooperation with project supervisors and authorities.

- Standardisation of pre-assembly/modularisation process.
- Manage design interface between design firms.
- Construction manual and guidelines for off-site material
- Simulation of life cycle cost.
- BIM simulation.
- Coordination of working drawing by changed design.
- Approval of working drawing and sample product.
- Document management.
- Engagement of property selling department.
- Discussing pre-requirements of major tenants.
- Establishment of mechanical engineering/electrical engineering facilities upgrade plan.
- Discussion with interior design team for detailed interior design.
- BIM simulation of potential design interference with work packages.
- Supporting interior mock-up test.
- Discussion of extra requirements from client and licensors before project closing.
- Management of documents for inspection of building completion.
- Establishing facility management system.
- Supporting environmental building certification.

These factors align to the concepts around concurrent engineering previously discussed. Almost total congruence of critical success factors for concurrent engineering as a design development and control philosophy can be seen with the work of Bhuiyan et al. (2006) in Table 2. Key to this is recognising the design management function as operationalisation of concurrent design optimisation.

Table 2. Concurrent engineering success factors.

Benefits of concurrent engineering
Schedules reduced for all concurrent engineering projects.
Delivery of defect-free prototypes accelerated.
Production yields improved.
Time to market shorter.
Why benefits were achieved
Early involvement increased planning horizon and learning.
Risks identified and trade-offs made earlier.
Specifications mostly correct since all functions present.
Constant involvement of operations delivered correct prototypes on time.
Operations and testing assisted in finding design problems before layout began.
Production issues resolved early.
Barriers
Lack of business unit and top management support.
Requirements hard to set at concept stage.
Lack of control of project resources.
Lack of interaction between hardware and software groups.
Lack of involvement by marketing at project start.
Concurrent engineering not well understood.

Overcoming the barriers
Create a multi-functional team at project outset and define member responsibilities clearly.
Dedicate necessary resources.
Improve new product development process.
Define requirements earlier.
Improve team communication and improve interaction of hardware and software groups.
Train members better: skills, IT tools and concurrent engineering methods.
Improve IT tools and increase use of simulation tools.

2.4 Technologies and techniques

2.4.1 Lean design methodologies

Last Planner was developed for production planning where workflow is continuously optimised. Ballard (2000) identifies Last Planner as being central to lean construction and further advocates the value of using set-based design to guide the process of design management. Set-based design is a parallel optimisation using design-led Monte Carlo simulation to keep options and interfaces fluid until the last safe moment to reduce design iteration. Sacks et al. (2010) note that simulation, reconfigurability and innovation are fundamental to using BIM for design development. Reifi and Emmitt (2011) go further to propose the idea of lean design management, recognising that six of seven types of waste in lean thinking also present in design management are:

- overproduction – iteration
- inventory – extra resources
- extra processing steps – each design member reports to a coordinator who -reports to other participants
- motion – tasks flow on time
- defects – lack of briefing
- waiting – delayed customer response.

Likewise, Pikas et al. (2015) noted that eliminating wastage through lean design management benefits design optimisation through early incorporation of key capabilities into process. Uusitalo et al. (2017) provide a useful summary of the critical tools for lean design (Table 3). Social processes are the management approaches adopted while methods are best thought of as unifying principles of operation.

Table 3. Lean design methods.

Social process	
Last Planner	Integrated concurrent engineering
Big Room	Collaborative planning in design
Co-location	
Methods	
Level of detail	Set-based design
Location-based design management	Choosing by advantages
Target value design	Real-time cost estimation
Tools/technologies	
Virtual design and construction	A3 report
Design structure matrix	Scrum
Dialogue matrix (design management)	

2.4.2 Building information modelling (BIM)

BIM is critical for any successful design management-based approach as a transformative technology with huge potential benefit to design optimisation (Sacks et al., 2010). Benefits include more accurate design, higher-quality deliverables, sustainable design, sustainable construction and lower life cycle costs of operations and maintenance (Table 4).

Table 4. Benefits of implementing BIM.

Design	Visualisation of form • Aesthetic and functional evaluation
	Rapid generation of multiple design alternatives
	Reuse of model data for predictive analyses • Predictive analysis of performance • Automated cost estimation • Evaluation of conformance to programme/client value
	Maintenance of information and design model integrity • Single information source • Automated clash checking
	Automated generation of drawings and documents
Design and fabrication detailing	Collaboration in design and construction • Multi-user editing of a single discipline model • Multi-user viewing of merged or separate multi-discipline models
Pre-construction and construction	Rapid generation and evaluation of construction plan alternatives • Automated generation of construction tasks • Construction process simulation • 4D visualisation of construction schedules
	Online/electronic object-based communication • Visualisations of process status • Online communication of product and process information • Computer-controlled fabrication • Integration with project partner (supply chain) databases • Provision of context for status data collection on site/off site

Research indicates successful BIM implementation depends on organisational ability to assimilate the tool. From a comprehensive literature review, Ozorhon and Karahan (2017) identified 16 factors that are critical to successful implementation of BIM (Table 5). BIM is an essential prerequisite of effective design management processes so a combination of these success factors is required for effective design management. In New Zealand, the BIM Acceleration Committee, which was established in 2014, developed industry awareness and publications to facilitate BIM uptake.[6] However, these efforts had mixed results. Doan et al. (2020) subsequently indicated significant knowledge deficits remain. Critical success barriers in New Zealand included lack of concept understanding, lack of benchmark projects, high economic investment, lack of expertise, lack of client demand, cultural resistance, legal issues, lack of collaboration and coordination, technical problems and lack of guidelines and standards.

[6] https://www.biminnz.co.nz/nz-bim-handbook

Table 5. Critical success factors for BIM implementation.

Variable	Definition
Availability of information and technology	Existence of necessary information and technology infrastructure within the organisation implementing BIM
Availability of financial resources	Ability of the organisation to allocate sufficient budget for BIM implementation
Availability of qualified staff	Existence of competent personnel within the organisation
Training of employees	Equipping personnel with necessary information and skills through training programmes, seminars etc.
Consulting	Receiving consultancy services from other firms, universities etc.
Supportive organisational culture	Existence of an organisational climate conducive to learning and implementing something new
Experience level within the firm	Existence of relevant previous experience in BIM implementation within the organisation
BIM policy of the company	Existence and effectiveness of a corporate strategy on BIM implementation
Effective leadership	Commitment and approach of top management to facilitate BIM within the organisation
Coordination among project parties	Existence of a cooperative project environment to successfully implement BIM
Project size	The scale of the project team in terms of its budget
Client requirement	Existence of a requirement specified or pressure exerted by the client
Awareness level of the industry	Familiarity with the industry and current level of application within the industry
Knowledge sharing within the industry	Existence of platforms (seminars, workshops, conferences etc.) that facilitate learning among different organisations
Appropriate legislation	Existence of BIM guidelines, standards and roadmaps within the industry
Government schemes	Existence of government-led initiatives to promote BIM implementation within the industry

2.5 Conclusion

Design management is understood as a specialist subdiscipline of construction project management (Andersen et al., 2005) and is a complex undertaking with a wide range of responsibilities and competencies. However, it lacks any common syntax or language because so many professional bodies have representatives employed in the role. The processes involved require a clear understanding of the critical success (and barrier) factors outlined above.

Philosophically, it seems clear that concurrency of activities (concurrent engineering) as well as early involvement of key stakeholders are central components of integrated design management. From a technological perspective, BIM appears to be the principal mechanism by which a syntax or language may be created to provide professional consistency for the future. The next key steps are to establish wider industry understanding of these issues as well as to plot a way forward.

3. Results

3.1 Survey findings

The findings reported in this section are based on the 540 responses to the online survey that investigated IDM competency in New Zealand. The survey targeted groups who interact with IDMs and project managers.

3.1.1 Demographics

Professional disciplines

Respondents who participated in the survey were skewed towards individuals within design-related professions (30% of responses). Other sizeable disciplines that are represented in the findings are main contractor (12%) and construction-side project management (9%). Each of the remaining disciplines represent less than 8% of all the responses (Figure 3).[7]

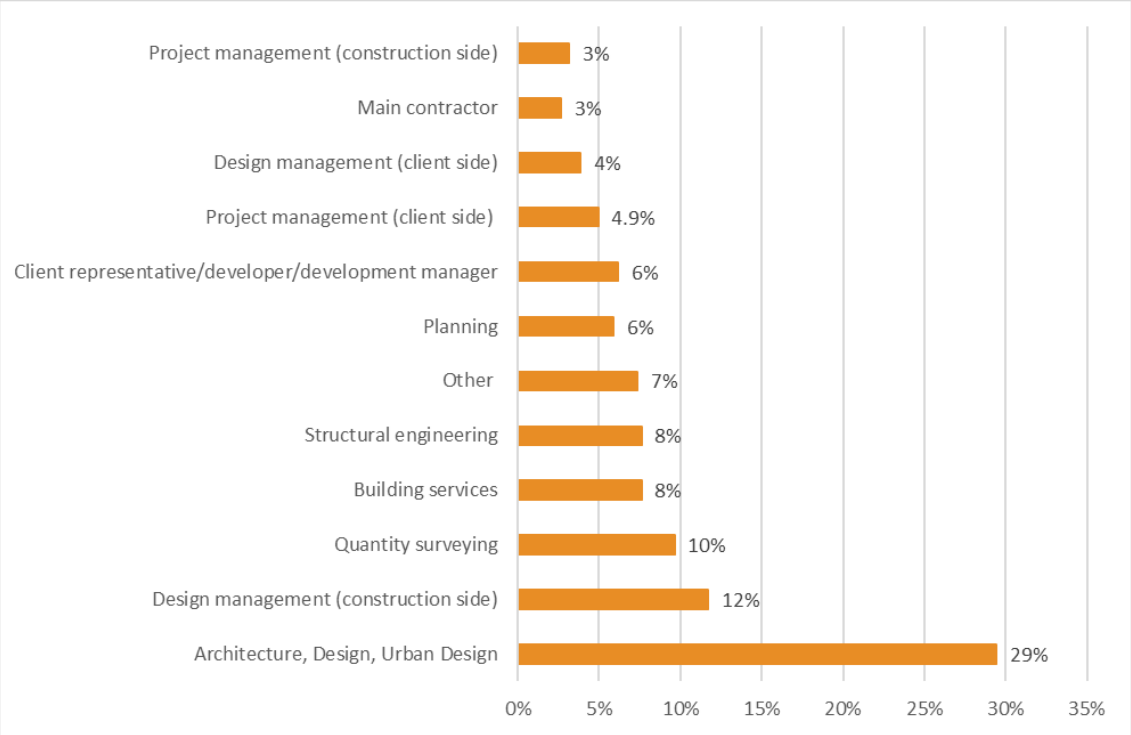


Figure 3. Disciplines of survey respondents.

Experience

Nearly two-thirds (60%) of respondents had worked in the industry for more than 20 years (Figure 4). With this level of significant experience among respondents, we can consider their observations to be authoritative.

[7] Respondents in these smaller categories included construction students, tutors, health and safety consultants, building inspectors, building surveyors, building officials, fire engineers, building materials suppliers, a conservation consultant, an environmental consultant and lawyers.

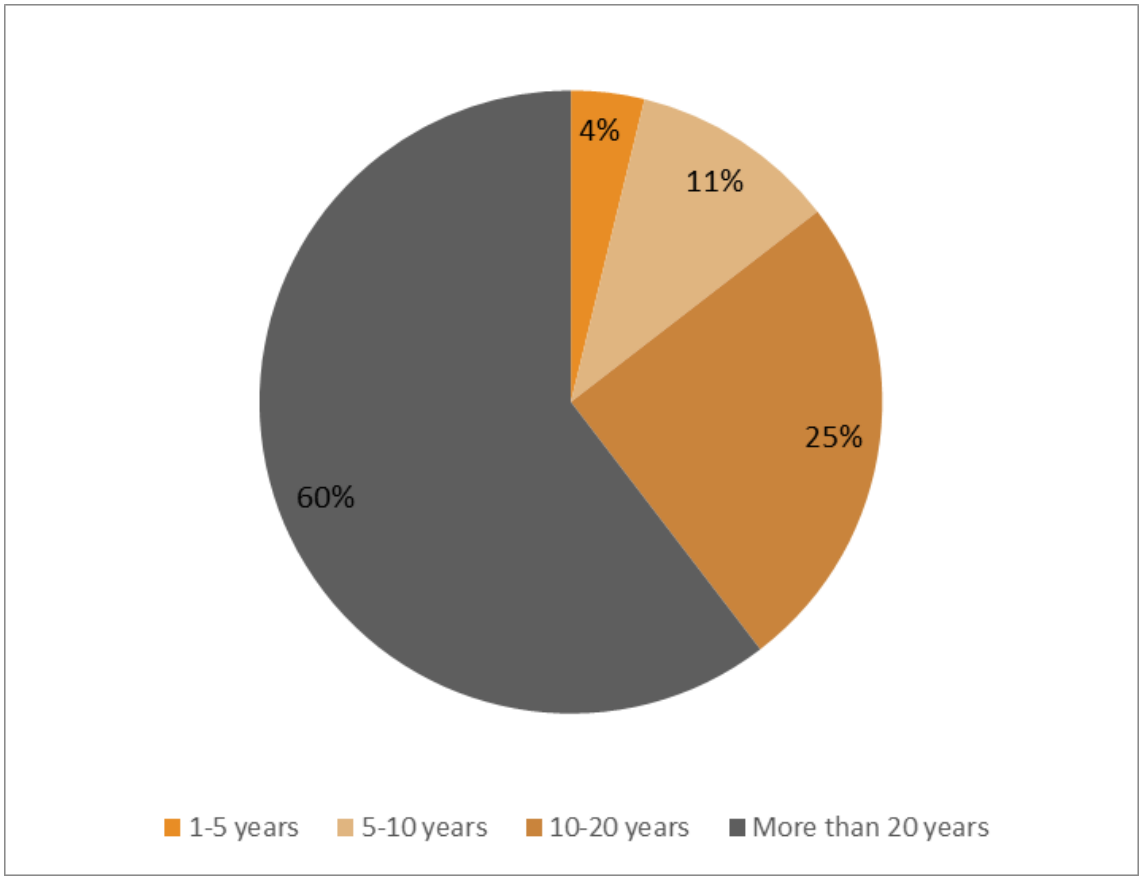


Figure 4. Survey participants' experience working in the building and construction industry.

Scale of projects

Most respondents were engaged in smaller projects, they valuing their typical project at less than $1 million (Figure 5).

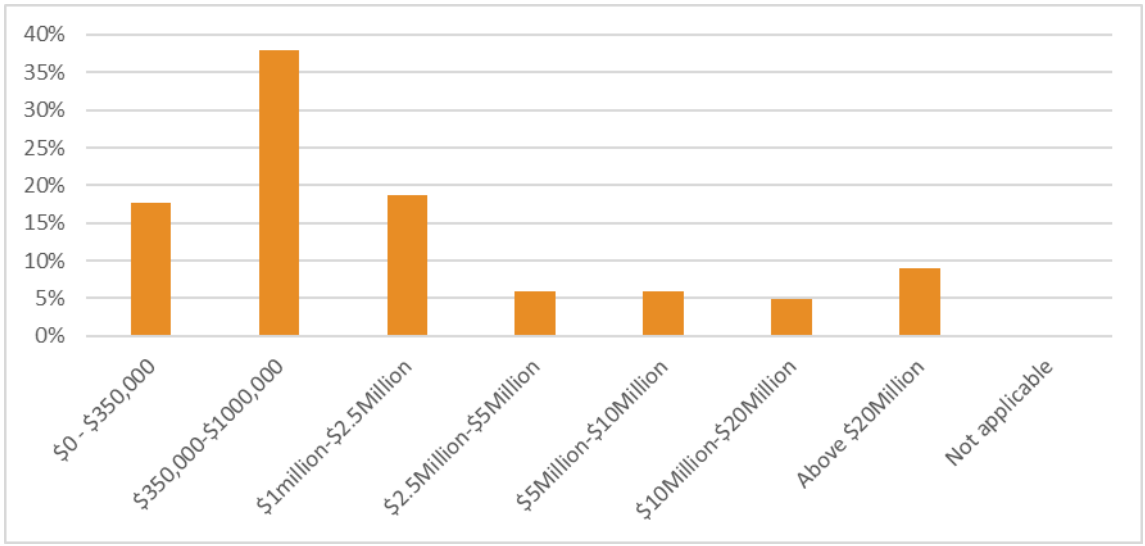


Figure 5. Scale of typical projects.

3.1.2 IDM interaction

Respondents said they interacted with IDMs at least monthly, if not weekly or daily. Higher build complexity equated to more frequent interaction with the IDM (Figure 6).

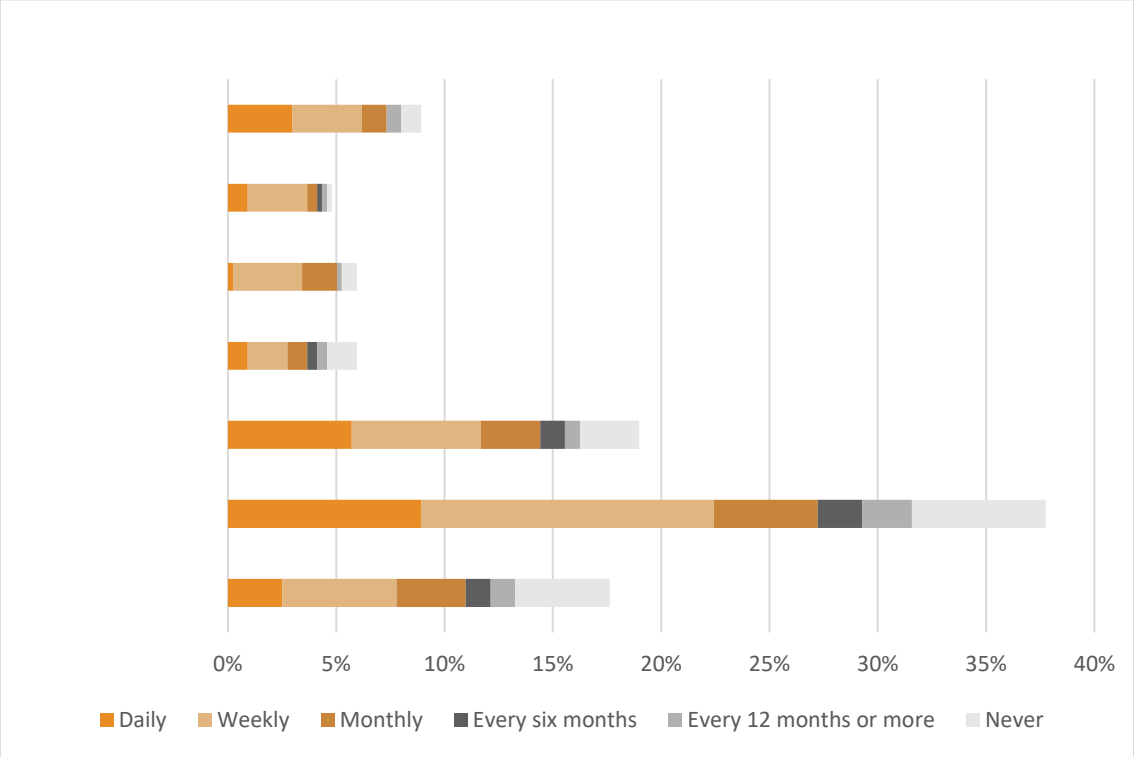


Figure 6. Percentage contact with IDMs versus project value.

Around one-third of respondents (35%) said they encountered project design management problems always or most of the time, while around a half (53%) experienced design management issues sometimes. Just 12% of respondents had rarely experienced design management issues in the past 3 years (Figure 7).

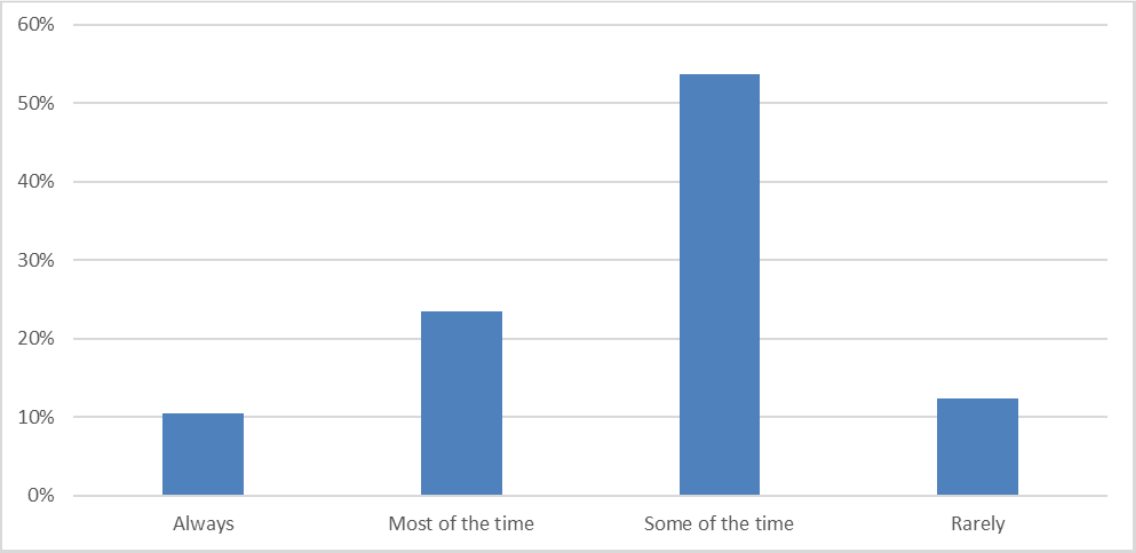


Figure 7. Frequency of participants' experience of design management issues over the last 3 years.

3.1.3 Critical competencies

Respondents identified 15 critical competencies for IDMs (the blue bars in Figure 8), with the four most frequently identified IDM competencies being:

- ensuring the design meets the client's brief
- obtaining client's design brief
- quality assurance of the design
- ensuring integration between design disciplines.

The survey also asked respondents how effectively they believe IDMs in New Zealand perform against the critical competencies they had identified. A net score (percentage generally competent minus percentage generally incompetent) was calculated for each competency (the orange dots in Figure 8). Respondents gave only one of the critical competencies – obtaining client's design brief – a high net competency score (close to 70%). They scored IDMs as largely effective (competency >50%) in:

- procuring design consultants
- giving project updates to clients
- managing consent application process
- chairing project team meetings
- coordinating consultant team responses.

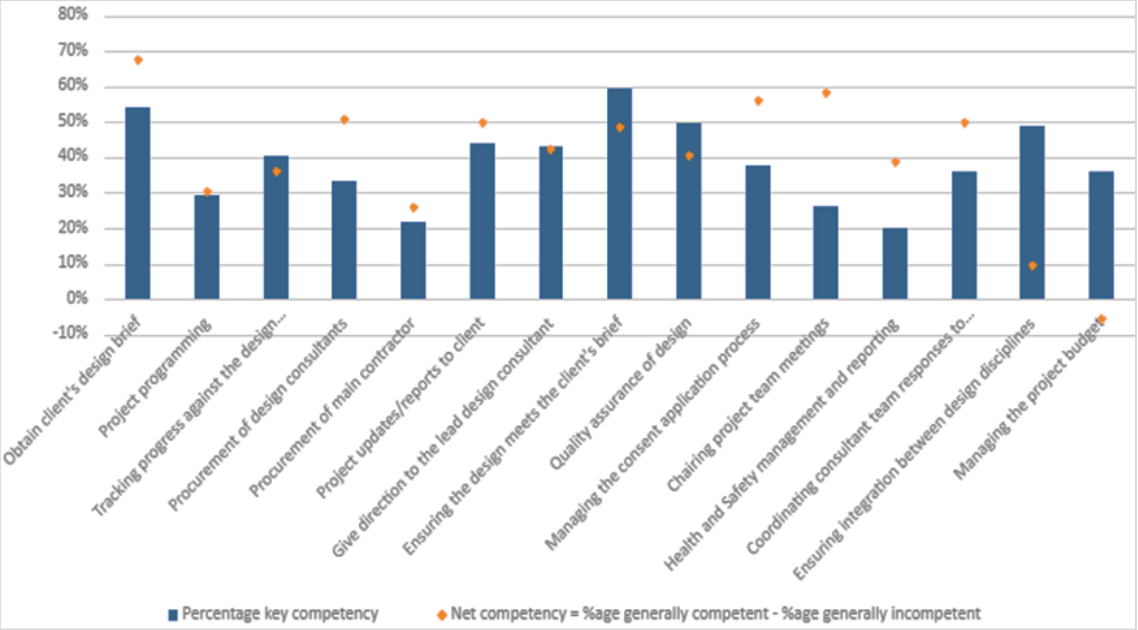


Figure 8. IDM key competencies.

Respondents scored IDMs at <50% net competency for nine of the critical competencies. Managing the project budget had a negative net competency score. The finding that IDMs are generally considered to be ineffective in managing the project budget is of particular concern given that budget management was identified as a critical competency by more than a third of respondents. Similarly, ensuring integration between design disciplines was identified as a critical competency by nearly 50% of respondents but they scored IDMs at only 10% net competency in this area. These results are significant – fundamentally, two of the key reasons for engaging IDMs were the competencies most lacking in these professionals.

3.1.4 Procurement versus design

Respondents were invited to detail whether procurement or contract types negatively affect design management processes. Nearly three-quarters (78%) of the 127 who responded to this question believed there is a negative association between contract type and design management processes, 14% believed there is no association and 8% were unsure. Design outcomes thus appear correlated to form and conditions of contract. Figure 9 shows the degree of linkage between contract form and impact on design process.

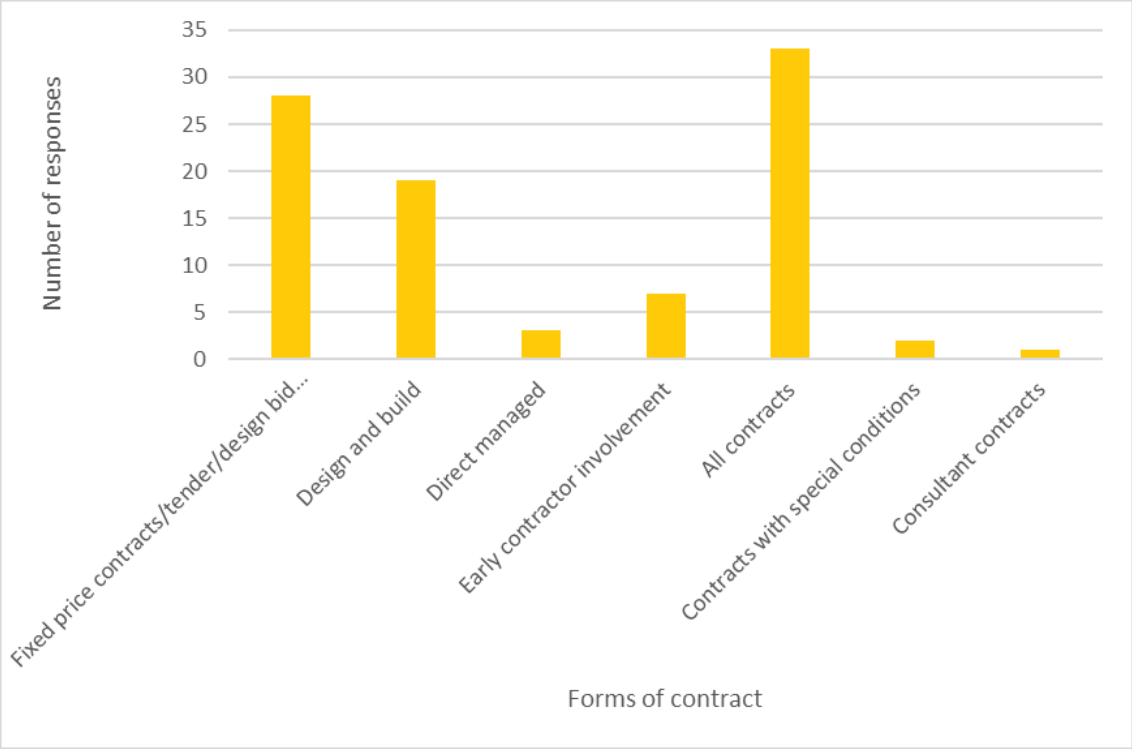


Figure 9. Procurement/contract types versus negative effects on design management.

More than a quarter of respondents said that the design-bid-build contract was the contract type most frequently identified as negatively affecting design management processes . Design-bid-build contracts are seen to pose challenges because this procurement method ties design (final built) outcomes to a fixed price without the contractor offering design input. Design-build procurement emphasises contractor-focused deliverables.

> [Design-build is] too contractor-protection focused without the ability to include oversight of independent engineer or project manager. [The inclusion of] an experienced independent project or DM oversight, taking a broad overview, sees upcoming problems before they occur. [Contractors lack perspective and do] not see issues till too late, resulting in waste, design compromises and [increased] costs. (Survey respondent)

Similarly, fixed-price, lump-sum tendered contracts depend on client representatives (IDMs) who are likely to not have technical design competency nor direct performance accountability.

Although design-bid-build was identified as being the most problematic, there was consensus among respondents that design management issues can occur with any procurement/contract arrangement. Any design issue originating from contract arrangements can be compounded by consultant (in)competency, poor client design understanding and design incompleteness at construction start.

3.1.5 IDM professionals adding value in construction

Figure 10 shows the degree to which the survey respondents believed interventions are necessary in various aspects of the design and development process. All elements are believed to be suitable for improvement. In particular, improved construction contracts (63%) and creation of a new professional framework qualification (64%) were identified as being ripe for improvement as well as expansion of existing qualifications. The survey results indicate broad recognition in the industry that contractual settings influence design outcomes beyond what otherwise-competent design professionals can influence.

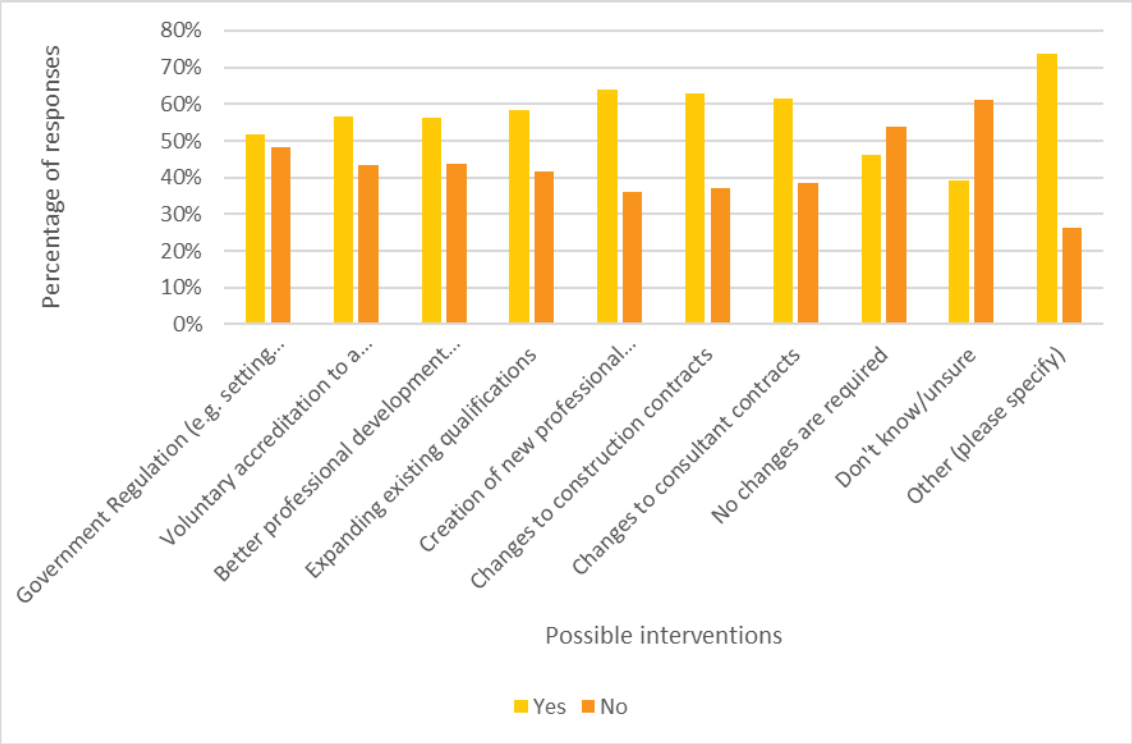


Figure 10. Changes to ensure design management professionals add greater value.

3.1.6 Conclusion

Design integration is central to IDM expectations. However, procurement and contract type have a significant impact on the ability of the IDM to deliver in this dimension. Contractual expectations critically affect design quality and move it beyond the IDM's control – irrespective of the experience or credentials of the IDM. IDMs need to go beyond competency and performance-benchmarking criteria and work towards influencing procurement and contracting frameworks.

3.2 Interview and focus group findings

3.2.1 Project complexity and safeguarding client interests

Interviewees recognised the risks associated with growing complexity of construction projects and the consequent need to re-evaluate the design management function. One interviewee used an orchestral analogy with the IDM as the conductor:

> [We have] moved from [a] chamber or quartet [to] a big orchestra … [We] need to work together – [client], stakeholders, engineers, fire engineers, the architect, council, the contractor. (Architect, Auckland)

Others commented that the integration offered by the IDM function offers value for the principal designers:

> [M]anagement of secondary consultants and specialists distract[s] principal designers. On big projects, a good DM [is] vital. (Engineer, Wellington)

IDMs were also considered to aid consistency across the build:

> [An] IDM [ensures] consistent understanding across project teams. (IDM, Auckland)

IDMs free up principal designers from administration, ensuring consistency of understanding and approach. Interviewees indicated that the ideal IDM has an ability to translate the client design brief into actionable, time-bound steps.

3.2.2 Critical competencies

While technical competency is central to the IDM role, increasingly, the IDM function needs soft skills to anchor the integration role. Communication is essential to success:

> [The IDM] needs to [balance] conflicting perspectives and [earn] respect from project stakeholders … When a [specialist talks] to an IDM, [the] IDM needs to speak the language of the specialist. (Architect, Auckland)

The technical basis of the IDM was a source of contention:

> I look at the [architectural] technology course I did a million years ago … largely construction science. But looking back … it was the most useful part of the course, [teaching] us to think analytically [in] terms of materials that would work. (Architect, Wairarapa)

Interviewees recognised that various disciplines based on a construction science background develop the analytical skills needed for the IDM role. Engineers and architects were identified as being best suited to 'IDM-hood', as these professions understand standards and legislation. Other interviewees, however, preferred ex-tradies, saying that "having worked their way up", ex-tradies come with a pragmatic understanding of building processes. Whatever the background, extensive experience is non-negotiable for an IDM:

> IDMs need to have [extensive] experience to know exactly what structural engineers [and quantity surveyors etc.] are interested in and what they will do. [A] minimum of 5–10 years' construction experience [is essential]. (Architect, Auckland)

3.2.3 IDM challenges

Duplication of IDM functions

Interviewees felt that, in spite of appointing IDMs, design coordination between project team members still saw some duplication:

> There is no IDM rule book. As builders, when a design issue occurs, do you call the architect or the IDM? [We've] got more to lose [in] liquidated damages [etc.] … a clearer rule book would be very, very useful. (Builder, Wellington)

One architect felt strongly that the design manager and architect roles were synonymous:

> Clients come to us, [and we] give you a coordinated project with the right people and get it across the line. (Architect, Wellington)

The distinction between the IDM and architect needs to be resolved. A clear competency framework would establish the IDM function within the build process.

Industry perception of IDM

Interviewees felt that the commercial model that design management firms operate, where an IDM might be spread over several projects, can lead to significant problems with projects they manage and result in poor quality and cost outcomes:

> Younger, less-experienced people working double hours a week to try to get promoted ahead … The damage being caused to projects, [clients'] capital project expenditure, [IDM personnel] is where pain is felt. It's a sweatshop. (Developer, Auckland)

An IDM, as the client representative, can integrate disparate design functions, and this unifying influence is one of two key components to achieving a successful project outcome. While the IDM sector is responding to a substantial requirement, employing an IDM does not address any fundamental problems underlying design failure.

Competency provision

Interviewees liked the possibility of a professional body representing IDMs to establish preferred competencies for IDM professionals, similar to those defined by the New Zealand Institute of Architects for their members. Tertiary qualifications for IDMs were not recommended. Rather, training should be with employers and supported by a professional body:

> Unfortunately, there isn't any control or oversight [by professional bodies]. I think that's needed to improve the quality of DM. (Project manager, Christchurch)

Credibility and consistency needs to be established in the profession. While the majority of interviewees were in favour of professional associations, some favoured tertiary-level education:

> You [need] credibility [and] formal education. [Maybe] a 1-year, block or a part-time course [after another] qualification – engineering, QS, construction, architecture even. Have this as a bolt-on rather than a separate course. (Developer, Auckland)

IDM competencies sit across multiple professions. A bolt-on course attached in addition to professional qualifications allied to previous industry experience would allow professionals from multiple disciplines to become IDMs. Ideally, an IDM qualification would be tied to a robust competency framework – a development that would add sure value to the industry.

3.2.4 Conclusion

Interviewees' understanding of key competencies for an IDM can be summarised as:

- technical design knowledge
- architecture or engineering background
- broad technical understanding
- communication and empathy skills
- extensive industry experience.

Architects should be able to provide these competencies – but apparently not well enough. Clients pass this responsibility to IDMs. Benchmarking performance standards could occur via tertiary training, post-tertiary professional development or voluntary accreditation to a professional association.

3.3 Expert review panel

An expert review panel was engaged comprising six senior construction professionals from across New Zealand's leading engineering, project management, architectural and quantity surveying practices. These experts were asked to look at the summary observations from the preliminary studies to gauge whether these perspectives are mirrored by industry leaders. The panel recommended a variety of interventions.

3.3.1 Review procurement practices

Industry experience and knowledge were acknowledged as essential. The panel felt the greatest improvements could be made by reviewing and revising standard commercial arrangements:

> [We need] a redraft of how commercial arrangements are working … [not] something the vertical sector has achieved but … commercial arrangements [are] affecting quality and competence of the service you get. (GM engineering consultancy)

This observation suggests the ideal effective design management blends commercial arrangements, enabling design integration and skilled IDMs to facilitate integration. Furthermore, industry should avoid tendering projects according to lowest price wins to ensure sufficient resources exist to provide comprehensive and collaborative design. The panel believed the IDM role should be reconceptualised without the artificial divide between the IDM and lead design consultant.

> The design manager should be employed as an independent consultant by the lead consultant. The independent design manager is [then a] key consultant of the lead. That design manager then coordinate[s] inputs and outputs of the team. (Director project management consultancy)

Recommendation

- If integration is critical, represent integration in design team composition.

3.3.2 Clarify the IDM role

The panel agreed the IDM role needs to be clarified, which could be achieved by making changes to the New Zealand Construction Industry Council (NZCIC) Guidelines:[8]

> Industry guidance could come from CIC guidelines [on how] design should be undertaken. A section on IDM could be included. Ideal to capture the role amongst other roles within the project team. (Director project management consultancy)

These comments reinforce the survey findings, which indicated that the lack of a clear definition of the role of the IDM makes expectations and accountability of the IDM challenging.

Recommendation

- Clarify the role of the IDM role through the NZCIC Guidelines to cement clear expectations of individuals holding an IDM function.

3.3.3 Include design integration in design education

The panel saw IDM as an accidental career destination rather than an initial planned career. Formal education was deemed important but also inadequate without practical industry experience. Integration in design and construction needs to be embedded across all disciplines.

The panel recommended industry begins developing an integrated education pathway between design and trades subdisciplines.

> Our industry is dominated by people working in silos. Educationally, we need to try and discourage this and get integration going. It would benefit the whole industry. [Ideally,] consultants [in] the design process should attend construction management type courses. [Similarly,] construction managers should do design courses. (QS firm director)

Echoing previous observations, the panel recommended establishing a programme tailored for experienced industry professionals to move into design management through professional development pathways:

> We need to avoid a graduate process where people [are] coming out [of universities] at 21–25 thinking they can run design processes – because without industry knowledge, they can't. We need an educational pathway, a postgrad diploma in DM where entry requires 10 years' experience. (QS firm director)

Recommendations

- Upskill IDMs and develop professional development pathways through tertiary training.
- Ensure IDM candidates have extensive experience.
- Develop transitional training to enhance skills deficits.

[8] https://nzcic.co.nz/wp-content/uploads/2015/10/0-CIC-2016-Preface-Preamble-Glossary.pdf

3.3.4 Conclusion

The panel's perspectives largely aligned with those obtained through the earlier stakeholder interviews, online survey and focus groups. The panel agreed the design management sector has emerged as a solution to increased technical specialisation in design and potential for design defects. The IDM role provides clients with project risk management.

The panel broadly agreed that the competencies required for an IDM included at least a broad knowledge of different design disciplines and the process of design as well as extensive industry experience. Project management skills were seen as complementary to these competencies.

The panel strongly supported revising procurement practices and defining the role of the IDM via the NZCIC Guidelines. Furthermore, to ensure that both designers and IDMs are better equipped to facilitate integration between design disciplines, the panel recommended the development of specifically tailored education programmes.

4. Conclusion

4.1.1 IDM systemic issues

Design-related outcomes are often beyond the control of IDMs. Contractual settings of construction projects are not always supportive of design integration. Design-bid-build often sees the built form being negatively affected by limiting early contractor input. Views diverged on why, with some survey respondents stating that it is because this method of procurement typically ties design outcomes as represented in the final built form to the fixed price of the contractor. Fundamentally, fees are not sufficient in traditional contracts to ensure comprehensive design. Other respondents, however, felt that traditional forms of contract that clearly delineate the project scopes of designers and constructors often rely too heavily on IDMs, who might not have a solid grounding in the technical design disciplines involved.

4.1.2 Sector-wide IDM best-practice education

A solution presented by our expert panel was to introduce a formal IDM role definition, including a general scope of responsibilities, within the NZCIC Guidelines. IDMs should be better equipped to facilitate integration between design disciplines on construction projects via an educational framework emphasising design coordination and integration between project stakeholders. This study has found broad industry recognition of a need for design management capability to develop solutions for more integrative design but not what the capability should be and how it should be executed.

4.1.3 Competency expectations

Study participants identified a broad suite of competencies for quality service delivery. The two most prominent areas of IDM underperformance, as identified by the survey respondents, are managing the budget process and ensuring integration between design disciplines. Soft skills and behaviours were heavily emphasised, rather than technical skills. The soft skills and behaviours needed to be a competent IDM include:

- communicating effectively with design, construction and commercial stakeholders
- design empathy – ability to understand diverse views
- a professional mindset with ethical standards and project management capability.

There was no common agreement among the study participants as to the best background for IDMs to come from. Experience in architecture, engineering, construction and other professions were all identified as being valuable for IDM professionals. However, there was general agreement that extensive industry experience is a main indicator of capability.

4.1.4 IDMs not meeting performance expectations

All the study's participants agreed that many IDMs are not meeting sector performance expectations. Several reasons for this were suggested and suggestions made how these could be addressed:

- Currently, there is no universally understood delineation between and definition of the respective responsibilities of the IDM and the lead design consultant. This creates confusion and becomes a performance issue for the entire project team (designers and builders) owing to confusion about lines of reporting and accountability. A clearer definition of the IDM role would help to address this.

- Guidance for IDMs was deemed necessary to ensure design integration and quality.
- Concern was expressed how consultancy firms employ young and inexperienced people into IDM roles to extract maximum financial value from their labour. The use of inexperienced professionals, badly stretched across multiple projects, flies in the face of industry expectations and inevitably diminishes design quality. Many felt the commercial model that DM firms currently operate needs to be re-evaluated.
- Procurement method was also identified as curtailing IDM effectiveness, which suggests that some issues associated with sector performance are related to factors that extend beyond the capabilities of design management professionals alone. Intervention to raise performance standards.

It is apparent that a sector-wide IDM competency framework and education is critical to future improvement of the design management profession. An enhanced understanding of the impact of commercial practices on design quality is also needed. Suggestions for improvement offered by the study's participants include a mixture of:

- tertiary courses tailored specifically to learning skills associated with design management
- professional development opportunities for people who already have industry experience in another area
- voluntary accreditation.

Quick wins for the design management sector could be found by selecting procurement methodologies that enable enhanced design integration such as design-build. It is recommended that the design-build procurement method be promoted to clients although it may not be suitable for every construction project.

4.2 Overarching recommendations

The findings of this study have resulted in four key recommendations.

1. **Define the role of the IDM and create a framework for best practice:** Explicitly define the role of the IDM within the New Zealand Construction Industry Council Guidelines and collect examples to establish a framework of best practice.
2. **Develop an educational framework for IDMs to benchmark performance and communicate best practice:** A formal investigation is needed to explore how principles of concurrent engineering could be adopted to advance the development of an educational framework for IDMs in New Zealand. This investigation could also assess whether the Design Quality Indicator (DQI) system (Page & Gordon, 2017) could be formalised and utilised as a competency framework for IDMs.
3. **Develop new qualifications for future IDM professionals:** In the short term, micro-credentials in the IDM discipline could be developed to supplement existing qualifications in related disciplines such as architecture, engineering and construction trades. In the longer term, stand-alone qualifications could be developed at postgraduate level to provide the necessary skills.
4. **Educate clients on how procurement methods can affect design outcomes:** The study has shown that procurement methods demarcate boundaries between design consultants, contractors and project stakeholders. The best solution would be to provide guidance on procurement methodology and forms of contract that enable effective design outcomes. Ideally, this would be an easy-to-access resource detailing benefits and risks of procurement options.

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