

B4BOX CITB FLEXIBLE GRANT PROJECT ON THE POTENTIAL OF MULTI-SKILLING IN CONSTRUCTION TO ADDRESS STRATEGIC INDUSTRY PRIORITIES

PROJECT RESEARCH REPORT

1. Introduction

Skills shortages, employee productivity, access to appropriate training and attracting new entrants to construction all present critical challenges to our industry. One solution that could positively address all of these challenges is the enhanced development and wider use of multi-skilling.

The following report explores the potential benefits of multi-skilling and was produced by B4Box, a construction-training provider hybrid, following independent support and guidance from academics at the University of Salford. The research included in this report consisted of four main approaches. Firstly, a analysis of existing literature to review the potential benefits and impediments to implementing multi-skilling in the construction industry. Secondly, development of a multi-skilling capacity tool that can be used to track the development of skills across different trades. Thirdly, a labour utilisation case study of single-trade versus multi-trade approaches. Fourthly, research interviews with different stakeholders to explore their understanding about multi-skilling.

The report is structured into two main parts. Firstly, the research review of benefits and barriers associated with multi-skilling. Secondly, a case study exploring the use of multi-skilling at B4Box.

2. Definition of Multiskilling

According to Burleson et al. (1998), multi-skilling is *“a labour utilisation strategy where workers possess a range of skills appropriate for more than one work process and are used flexibly on a project or within an organisation. Workers can be assigned to construction tasks based on their ability to perform the needed skill/task, not limited to traditional job boundaries”*.

A multi-skilled construction trade operative is an individual who possesses a variety of skills and applies them to work tasks that fall outside the traditional boundaries of a single trade. This enables them to be an effective and productive contributor in more than one work process (Burleson et al., 1998; Hass et al., 1999; Gomar et al., 2002).

Multi-skilled operatives may have a primary single trade in which they are highly proficient and fully-qualified but may also have additional skills so they could be assigned tasks outside traditional trade descriptions and work boundaries, so therefore their role in a construction project is not limited to just one trade or activity.

Although it might be possible for a multi-skilled operative to have achieved qualifications in several trades, in practice it is not necessary for workers to possess mastery level skills in multiple trade areas to still be utilised as a multi-trade operative - being able to perform the needed skill or task effectively can be sufficient. It has been argued that the number of trades in which workers are proficient should be determined by the number of skill assessment tests they can pass (Hass et al., 1999). However,

such assessments can be expensive for employers to implement and it has been pointed out that although currently there is no shortage of vocational qualifications to support the multi-skilling of workers, employer uptake remains relatively low (Radley, 2015).

Fundamentally multi-skilling can be considered as job enlargement and skill broadening by increasing an individual's skills and competencies. This enables operatives to cover a larger proportion of production activities and to carry out tasks previously or traditionally carried out by another function (Horbury and Wright, 2001). Although the above descriptions are skewed towards multi-skilling trades people, which reflects the most common and widely recognised form of multi-skilling, it should be noted that multi-skilling can also be apparent amongst administration and supervisory work (Horbury and Wright, 2001).

3. Categories of Multi-skilling

For the purposes of this review multi-skilling can fall into the following categories as defined by Cordery (1995).

Horizontal Multi-skilling: Learning and using skills from another trade discipline within construction, for example, a plasterer using painting and decorating skills or a plumber developing carpentry skills. Cordery (1995) identified two main types of horizontal multi-skilling. Skill broadening – where minor elements and tasks are learned on top of the predominant activity so expertise is maintained in the major task with elements added to increase efficiency. Dual-skilling – where another major activity is learned in addition to the main trade and a person is considered competent to carry out any activity in these two main disciplines. Cross-skilling could be viewed as an extension of dual-skilling across several different trades. Horizontal multi-skilling across several trades (cross-skilling) is the main form of multi-skilling considered in this research.

Vertical Multi-skilling: The extent to which supervisory or administrative support tasks are taken on by individuals, for example, a worker takes some element of management, e.g. scheduling, quality control, material purchasing. This could be a team leader or a member of a self-managed team as a form of empowerment. Conversely, it could also be a supervisor or working foreman in construction taking on some of the skills and tasks of operatives such as installation or finishing.

Depth Multi-skilling: This is the acquisition and application of more complex, specific skills within the same trade or discipline, for example a joiner acquiring advanced skills, such as complex staircasing or roof structures. This type of multi-skilling was not examined in detail during this study.

Multi-skilled Teams: A multi-skilled team is a group of individuals who collectively have a range of skills - with the intent being to have a team that is competent in all of the skills required to complete a project. A multi-skilled team could be composed of traditional single skilled individuals who collectively cover all trades or a team of multi-skilled individuals.

4. Benefits of Multi-skilling

The benefits of multi-skilling have been grouped into company/project and individual operative benefits.

4.1 Company/Project level benefits

Project / Firm Benefit	Overview
Increased Productivity	Construction managers have estimated a 20% productivity increase from multi-skilling (Haas et al., 1999). A major contribution to increased productivity from multi-skilling is because of more efficient use of labour resources and time on construction sites (Haas et al., 1999). The demands for specific work specialties for single-trade labour result in idleness for some workers and a backlog for others resulting in knock-on productivity complications to be managed that multi-skilled teams do not (Aquilano, 1977).
Reduced Trade Interfaces and Idle Time	Multi-skilling enables smoother work flow (Burlison et al., 1998) with reduced idle time, reduced dead time between tasks and fewer trade interfaces. Workers who are skilled in only one trade may sit idle while waiting for work to become available, whereas a multi-skilled workforce moves with the workload instead of waiting for the work to come to them, resulting in fewer idle work hours and reducing the cost to the business. The more multi-skilled operatives are involved, the less buffering in the programme for downtime (Lill, 2009). With multi-skilled teams, there is also no need to change crews, unlike with a single-skilled workforce (Haas et al., 1999), and this can be very useful at the final stages of projects when there can be time pressure to complete jobs.
Reduced Construction Duration	Using multi-skilled workers makes it possible to shorten the relative construction duration by approximately 20% due to a more uniform and full workload for operatives (Lill, 2009). It has been argued that with a multi-skilled workforce, an activity is usually accomplished in shorter period time because the workers are more efficient (Haas et al., 1999). A shorter construction duration can help clients realise a return on their built environment assets sooner.
Reduced Number of Operatives	One of the tangible benefits from multi-skilling for companies is to reduce their number of operatives. Multi-skilling, by equipping personnel with the skills to carry out a greater variety of tasks, means that employment levels can be reduced (Horbury and Wright, 2001). Multi-skilling can reduce the total workers coming onto the job site and mean that fewer workers from different trades are needed to complete a project. Construction research has demonstrated a 35% reduction in required total hires (Burlison et al., 1998). The traditionally accepted single-skilled strategy is not necessarily responsive to the construction sequence or the optimal use of worker skills and thus a better utilisation of the existing workforce through multi-skilling may deliver improved project performance. This also provides a cost-efficient solution to recruitment problems that construction firms face at a time of skills shortages because fewer

	workers need to be recruited. The impact of unavailable trades on projects and clients can therefore be minimised.
Reduced Labour Costs	<p>One of the major benefits of using multi-skilling in construction is project labour cost savings (Haas et al., 1999; Tam et al., 2001). Construction firms surveyed in the US have implemented multi-skilling primarily to reduce their labour costs (Haas et al., 2001). Carmichael and MacLeod's (1993) research in Japan demonstrated that there are significant savings in labour costs after implementing multi-skilling. Cross (1986) found that the direct labour costs were reduced by between 20 and 25% following organisations' implementation of multi-skilling. Meanwhile a detailed construction research study demonstrated the benefits of multi-skilling would be a potential 5-20% labour cost saving (Burleson et al., 1998). Simulation research into the benefits of multi-skilling has also shown to decrease the construction cost price through improving workload characteristics and a consequential shortening of the construction duration (Lill, 2009). Combining four trades has been estimated to decrease the cost price around 3% and increase the potential owner's revenue by approximately 7% (Lill, 2009). Meanwhile a further beneficial saving from multi-skilling to reduce labour costs is the potential to reduce overtime expenditure. Although it might be more expensive to pay workers for the additional skills they have acquired, research analysis of available returns from the perspectives of a construction firm and client reveal that it is worthwhile for both of them to invest in multi-skilled operatives, (Lill, 2009). Research has also suggested contractors can "carry" an additional two percent of workers in order to accommodate absent employees without disrupting the flow of work (Burleson et al., 1998) but having a multi-skill workforce able to cover different roles can help to reduce this percentage and cost.</p>
Continuity of Workforce	<p>Multi-skilling can significantly increase in average employment duration of workers at the project site, which results in workforce continuity, longer and more stable employment opportunities and lower employee turnover for companies. Research has demonstrated a 47% increase in average employment duration for multi-skilled workers per project (Burleson et al., 1998) reducing the learning curves new operatives would have to go through and improving the social capital and teamwork relationships that can be built. Multi-skilling as a labour strategy allows for improvements to employees' conditions, thereby supporting the attraction and retention of operatives (Haas et al., 2001).</p>
Planning Efficiency	<p>In a business with a flexible multi-skill workforce, planning and scheduling activities can always focus on the needs of the customer and as oppose to just on the capabilities of the staff. Planning and scheduling multi-skill workers can enable changes to the production schedule to meet customer demand and programme requirements without a loss of productivity. Compared to multi-skilling, the efficiency of single-trade specialisation is primarily guaranteed by having the necessary quantity of work, and if a stable and uninterrupted workload is not possible labour productivity can fall</p>

	<p>dramatically as a result of the fluctuation (Lill, 2009). For single-skilled operatives, overloads and slack periods are unavoidable (Lill, 2009). Narrow specialisation is effective only if all workers are provided with work, otherwise efficiency falls because for single-skilled workers, with work broken into small pieces, each piece or task involving a single skill makes the scheduling process very complicated or even impossible for smaller companies (Haas et al., 2001; Lill, 2009). With single-trade labour the fact that there are normally several specialised teams on the building site at the same time requires precise coordination of their work in terms of time and space (Lill, 2009). Multi-skilling does not present the same problem for construction planners.</p>
<p>Workforce Flexibility</p>	<p>Flexibility, in the form of multi-skilling, is where individuals are competent in several tasks, and therefore can move from job-to-job to provide cover for spikes in work, absence and training (Horbury and Wright, 2001). Organisations typically multi-skill with the intent of removing functional barriers and demarcations increasing the flexibility of the workforce (Horbury and Wright, 2001). There is therefore added flexibility available to construction managers and supervisors in assigning tasks (Williamson, 1992) and workers can be moved across a spectrum of work to where they're needed from one job to another. This provides the employer with the ability to schedule and arrange workers to best suit the needs of the business and means that workers can fill in for absent employees and work in different areas the business requires and for any duration. This enables production levels to be maintained under any circumstance. It can also facilitate individuals to gain further skills, leading to an even more highly skilled and adaptable workforce (Horbury and Wright, 2001).</p>
<p>Improved Quality</p>	<p>Research has confirmed the positive impacts of multi-skilling on project outcomes such as improved quality (Williamson, 1992). Stewart (1999) found that after implementing multi-skilling, operatives generally improved their knowledge of work, leading to better understanding of integrated construction activities and the interfaces between trades to improve quality. This can include increasing the likelihood of getting work right first time because multi-skilled workers can immediately correct snags from other workers without having to recall them to site. Lill (2009) argued it is reasonable to keep a multi-skilled team on a permanent basis to improve the quality of work, whilst also raising the workers' loyalty towards their employer.</p>
<p>Improved Safety</p>	<p>Research has confirmed the positive impacts of multi-skilling on improved safety (Williamson, 1992). With a greater understanding of other trades multi-skilled workers are more aware of potential hazards around them and because they stay on projects for longer periods they will have a better understanding of site risks compared to new entrants. Previous studies have shown that most accidents occur in the initial period on a new site (Burlinson et al., 1998). When multi-skilling is used, it is also important to ensure from a health and safety perspective that efforts are made to ensure that skills are adequate and competence is maintained in all tasks (Horbury and Wright, 2001).</p>

<p>Increased Innovation</p>	<p>Specialisation strategies have been identified in other industries as a restricting factor in the implementation of new technology and in the development of process-based innovations. Such studies indicate that when work boundaries are crossed, shared, merged, or eliminated, new opportunities for innovation arise (Burlinson et al., 1998). From a construction industry perspective, multi-skilled labour utilisation strategies may provide increased opportunities for the development of process innovations and technology implementation (Tatum, 1989).</p>
<p>Competitive Advantage</p>	<p>Simulation experiments have proved that multi-skilling should interest the business models of both contractors and clients (Lill, 2009). Surveyed companies believe multi-skilling makes them more competitive because more flexible labour utilisation is possible (Haas et al., 2001), whilst the impact of labour skills shortages can be minimised by a flexible workforce. In addition, maintaining a core, multi-skilled workforce ensures that contractors have the base for undertaking new projects, which further enhances the flexibility and competitiveness of firms (Haas et al., 2001).</p>

4.2 Operative Level

The following benefits of multi-skilling were identified for operatives.

Individual Benefit	Overview
Increased Earning Potential	<p>A major benefit accruing to multi-skilled workers is increased wage earning potential. Increased versatility and skills add value and enable increased income (Burleson et al., 1998). One way earning potential is increased because of the increased employment duration on projects and with companies. An operative who is multi-skilled can expect to work more hours during a given year than a non-multi-skilled counterpart, as a result the worker will have a higher net income (Carley, 1999; Haas et al., 1999). Firms are also willing to pay higher wages to a multi-skilled worker than a single skilled one. One study based on an extensive survey concludes that workers with a wider skill range do earn a higher annual income (Carley, 1999). In another study when workers develop new skills their wages increase at 90% of companies surveyed (Haas et al., 1999). Even if highly skilled workers' complete tasks where they only use basic skills they still receive the same wage rate (Haas et al., 1999).</p>
Increased Employment Duration on Projects	<p>A worker benefit of being multi-skilled is longer employment duration (Gomar et al., 2002). Multi-skilled workers are capable of undertaking different types of work, meaning their job opportunities are not limited to just one trade. Furthermore, because multi-skilled workers can perform multiple tasks, they can be employed through many phases of the project, which both enable longer employment duration. A research survey revealed the increased employment duration to be one of the most commonly reported worker benefits (Burleson et al., 1998). Increased employment duration will reduce the periods of non-work from layoffs and unpaid periods when workers have to find and wait for the next project to start.</p>
Increased Stability and Security of Employment	<p>The employment of construction operatives is characterised by instability, finite and fragmented durations of employment but it has been argued by Carmichael and MacLeod, (1993) the job security of a multi-skilled worker is higher than the single-skilled one. The number of moves and relocations between employers and geographic areas can be reduced because of the capability to do different types of work. Employers have an increased economic interest in retaining their multi-skilled workers from project to project (Burleson et al., 1998), reducing the number of job changes required to find work and avoiding the necessity of relocating to different areas because they can work at one location across a number of trades (Haas et al., 1999). This can improve opportunities of remaining in secure and stable employment within the same geographic region, closer to home with positive quality of life benefits.</p>
Increased employability skills and attractiveness to other employers	<p>Multi-skilled operatives are often more attractive to employers than single skilled operatives, because firms would rather hire a person who can do a variety of tasks than a person who can only perform one task. More skills and more qualifications generally result in increased employability (Gomar et al., 2002). Stewart (1999) found that multi-skilling operatives also had improved understanding of integrated construction activities increasing their attractiveness to employers.</p>

<p>Improved Job satisfaction</p>	<p>Multi-skilling has been widely identified as improving operatives job satisfaction and quality of working life (Burleson et al., 1998; Haas et al., 1999; Gomar et al., 2002). The aforementioned increased employment duration contributes to a sense of improved job satisfaction for multi-skill operatives (Burleson et al., 1998). Job satisfaction and wellbeing has also been seen to increase among the multi-skilled workers through greater rotation and work variety which means they don't have to undertake the same kind of job all of the time (Haas et al., 1999). Furthermore, multi-skilling may increase worker motivation by encouraging greater participation and engagement in work processes and improving the attitude of workers and increasing their desire to perform (Haas et al., 2001). Improved employee satisfaction can increase morale in a business which can lead to increases in productivity and employee retention rates.</p>
<p>Greater opportunities for career progression</p>	<p>Multi-skilling gives workers more possibilities to advance and develop a career path (Haas et al., 2001). Multi-skilled construction workers can continue to develop and broaden their skills, their earning potential, and should experience expanded career options throughout their construction careers (Burleson et al., 1998). Increased pay and promotion opportunities through gaining additional skills could help to retain existing workers in the industry. Whilst the quality, secure, long-term satisfying careers that multi-skilling offers could arguably hold greater appeal to young workers than single trade jobs and thus help to attract new entrants to enter the industry. Multi-skilled workers should not be as threatened by obsolescence when new technology changes construction methods of production, because they are used to learning new skills and can adapt to changes in production. Multi-skilling also gives workers the opportunity to develop skills that will allow them to maintain a good job even if they develop physical limitations (Haas et al., 1999).</p>

5. Barriers to Implementing Multi-skilling

The following impediments to multi-skilling were identified in the literature review.

Barrier	Overview
<p>Change traditional industry practice</p>	<p>According to recent research the most important barrier to overcome to implement multi-skilling is changing the current industry practice which has been in place for many years (Lill, 2009). Traditional industry practice presents a range of impediments from a general resistance to any change through to legitimate concerns that multi-skilling might dilute competence standards, with the risks of lower quality and safety (Radley, 2015). To benefit from multi-skilling, changes in companies' management systems and structures are required (Haas et al., 2001). In some sectors, labour workforce planning practices that are designed around traditional single trade definitions will have to be modified to fully utilise a multi-skilling labour strategy (Burlison et al., 1998). In two studies research respondents felt that some complex tasks and projects did not lend themselves to multi-skilling (Burlison et al., 1998; Lill, 2009). Single-skilled operatives have been argued to achieve higher productivity and can raise their skill levels more easily as the same operations are frequently repeated, therefore, compared to broader multi-skilling the higher the level of single-trade specialisation the higher the quality of work and potentially the higher productivity that can be achieved (Lill, 2009). The success of multi-skilling greatly relies on a supervisor's ability to assign workers to appropriate tasks and to compose teams effectively (Gomar et al., 2002). When recruiting and deploying multi-skilled workers accessing adequate information regarding the skills of each worker presents problems (Burlison et al., 1998). When combined with different rates of pay for different trades remuneration problems can be a further barrier to implementing a truly multi-skilled approach (Burlison et al., 1998). The higher wages paid to multi-skilled workers might put some employers off, although it is argued when utilised properly, the multi-skilled workforce, should generate savings, because of higher productivity (Burlison et al., 1998). Finally, the structure of the UK construction industry also presents a barrier because of the impracticalities of fully adopting multi-skilling in an industry that is dominated by very small firms – with over 90% of UK's construction enterprises Small or Micro sized.</p>
<p>Training constraints</p>	<p>As Lill (2009) has pointed out implementing multi-skilling across the industry cannot happen overnight with only a fraction of the workforce skilled and qualified in a variety of trades. The majority of operatives require training and assessment to become multi-skilled. This will require investment and provision of quality training which present additional barriers. There can be a high training cost for solely single trade operatives to become multi-skilled. Contractors typically have limited resources to make such investment (Haas et al., 2001). Considering the common practice where firms prefer not to tie themselves to a permanent workforce and the perception that qualified operatives might choose to leave to competitors, it is difficult to convince contractors to invest in training (Lill, 2009). In</p>

	<p>addition, even if sufficient finance for upskilling and multi-skilling may be available, studies have revealed that most respondents believe another major impediment is a lack of quality training provision (Lill, 2009). This includes a difficulty in developing multi-skilled craft tests. Mainstream training provision has been criticised for teaching “yesterday’s skills” and being structured around traditional industry trades with a current propensity towards a silo approach, as oppose to the interdisciplinary training required for the future (Vokes and Brennan, 2013). For individual operatives, the limited availability of training provision, a lack of opportunity to gain wider on-site experience, and having to pay for one's own training and qualifications are all potential training constraints. For some individual operatives it might not possible to expand their skills very quickly if their primary trade is not skilled enough.</p>
<p>Operative Reluctance to Multi-Skill</p>	<p>Respondents to a research study agreed that impediments to multi-skilling include worker resistance (Lill, 2009). This can include an attitudinal lack of interest in more training, with some operatives viewing it as threatening rather than as a process of ongoing development, as well as expectations of being refused time off for training, and a lack of time and unwillingness to undertake training outside working hours. The compensation for multi-skilling must be high enough to motivate operatives to learn additional skills (Lill, 2009), and they need to be sure that their effort will be appreciated in monetary terms and that they will be paid better after learning additional skills (Lill, 2009). Even then there are still problems of image and identity to be overcome including negative connotations like ‘jack of all trades and master of none’. Multi-skilling suffers from divides between professions which are reinforced by the supporting infrastructure of career pathways as well as by trade and professional bodies, many of which are based on single occupations (Radley, 2015). Whilst union trade jurisdictions and work rules may hinder the implementation of multi-skilling in certain areas as unionised workers perform tasks only within their trade jurisdiction (Haas et al., 2001). Furthermore, organisational flexibility should not be at the expense of individual health through overloading operatives and a perceived lack of control and competence. Working beyond ones’ limits is a known stress factor (Horbury and Wright, 2001).</p>
<p>Diminishing Benefits from Multi-skilled Workers</p>	<p>As with any innovation there is a risk of failure to deliver predicted benefits and an organisation that makes the decision to multi-skill their workforce to drive up productivity could experience disappointing results and unintended consequences. Previous research has determined that, when breadth or percentage of multi-skilling is increased beyond a certain point, the benefits become marginal. It is argued that extreme skill aggregation will eventually produce diminishing returns to projects and industry because the infrequent use of skills makes maintaining some skills difficult and training costs may eventually outweigh the benefits of the increased flexibility provided through multi-skills (Burlison et al., 1998). Development of a fully multi-skilled work force is probably not economically efficient or desirable. The endless mastering of</p>

	<p>additional skills cannot be reasonable and might lead to negative results (Clarke and Wall, 2000). One study found that as the percentage of multi-skilled workers was increased over 20%, the benefits of multi-skilling did not always continue to increase (Gomar et al., 2002). The benefits to workers themselves have been found to become marginal after acquiring competency in two or three crafts (Gomar et al., 2002). The influence of combining more than four trades is relatively insignificant, as is the effect of using different specific combinations of trades (Lill, 2009). Meanwhile, a deterioration of infrequently used skills is argued to be inevitable (Burleson et al., 1998).</p>
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6. Case Study of Multi-Skilling at B4Box

6.1 Why and How

B4Box is a hybrid social venture providing construction contractor, training and social enterprise services. B4Box introduced multi-skilling to support the development of our workforce and improve the competitiveness of the company in delivering projects. Multi-skilling is the optimum labour strategy for our work in the building repair, refurbishment and maintenance sectors of the construction industry providing flexibility and efficiency.

Although B4Box are advocates of multi-skilling the company workforce is not 100% multi-skilled. The company still employs a number of specialist single-trade painters, plasterers, plumbers, joiners and groundworkers. Specialised workers are required for the projects that involve intensive single-trade skills, or skills that have limited coverage across the multi-skilled workforce.

Any single trade employee that wishes to become multi-trade would be encouraged to do so, with the company taking on the challenge to enable that to happen within the constraints of project delivery. One example, of how B4Box have been able to encourage the development of multi-skilling is through integration of different work programmes including empty property repair and refurbishment, environmental works, tenanted programmed works like kitchen and bathrooms replacement, and external works like roofing and groundworks. This enables the transfer and rotation of operatives and apprentices between programmes which means employees can participate in many types of activities and learn new skills. The skilled workforce we employ have a responsibility to train new entrants on-site and pass on their skills and knowledge. This means that B4Box provides a culture where learning multi-skilling is the norm. The majority of new apprentices (95%) undertake multi-skilling apprenticeships.

To maximise multi-skilling across a mixed workforce of multi-skilled operatives, single-trade specialists and apprentices, B4Box Management and Supervisors have to decide which jobs require which operatives. The skills of all available operatives must be balanced against project requirements, overall company workload and development opportunities for individuals wishing to upskill. This frequently necessitates that lower level simpler tasks are allocated to people who are in development (multi-skilled would be under-utilised and expensive) and that technically demanding, highly skilled work is allocated to single-trade specialists. This subsequently means that sequences of inter-related, mid-skill level activities can be grouped together to be undertaken by competent multi-skilled operatives, efficiently and to the correct standard first-time.

6.2 Multi-Skill Capability Mapping Tool

B4Box have developed a Multi-Skill Capability Mapping Tool, shown in Figure 6.2, to track skills development over time and demonstrate the journeys of new entrants to become productive multi-skilled operatives within 18 months. The Capability Mapping Tool was used at three points in time to show the breadth of multi-skilling achieved and the proficiency of skills developed at (a) the beginning of the apprenticeship, (b) mid-way through the apprenticeship at the end of the Diploma (technical cert) qualification and beginning of the NVQ (on-site workplace competency) qualification, and (c) the completion of the apprenticeship. At each point in time we collected multi-rater feedback on capabilities through involvement of trainers and workplace supervisors as well as apprentices themselves. From a learner and trainer perspective, the value of the tool to track progress is self-evident, but we have found that by including supervisors in the rating dynamic great additionality can ensue. For example, there is improved transparency and openness between all stakeholders on their respective views on an apprentices' progress in different trades, which then speeds up development. Furthermore, a supervisor can use the tool to ensure sufficient development opportunities are provided to each apprentice across different trades and there is clarity on which trades and tasks remain outstanding to help prioritise work allocation. Finally, supervisors can also reference back to the tool when composing different teams to ensure the necessary coverage of skills for specific projects.

Figure 6.2 Multi-Skill Capability Mapping Tool

Tasks	Trade Area
Joinery trade skills	
JCore	Core joinery trade skills: measuring, marking out, cutting, fitting, splicing, levelling, finishing, positioning and securing.
Task J1	Remove/repair/replace door and window frames
Task J2	Remove/repair/replace windows and doors including UPVC
Task J3	Ease, repair or renew doors including glazing and ironmongery
Task J4	Remove/repair/replace partitions
Task J5	Remove/repair/replace skirting
Task J6	Remove/repair/replace floorboard and floor joist coverings
Task J7	Remove/repair/replace service encasements
Task J8	Remove/repair/replace wall and floor units and fitments
Task J9	Remove/repair/replace work surfaces
Task J10	Remove/repair/replace gates, posts and fencing
Masonry trade skills	
MCore	Core masonry trade skills: measuring, marking out, removing, laying, positioning and securing
Task M1	Build brickwork including cavity walls, openings and damp course
Task M2	Patch pointing to areas of damaged brickwork
Task M3	Fit a new waste pipe through cavity walling
Task M4	Remove, replace and reinstate paving slabs and block paving
Task M5	Set out and lay concrete
Plastering trade skills	
PCore	Core plastering trade skills: measuring, marking out, cutting, keying and brushing, applying and finishing.
Task P1	Prepare brick, stone and block backgrounds to receive plaster
Task P2	Prepare and apply finishing plasters using one, two and three coat plastering
Task P3	Repair plasterboard on existing stud walls and ceilings
Task P4	Repair wall and ceilings surfaces in plaster with backing coat and skim finish
Plumbing trade skills	
PBCore	Core plumbing trade skills: fault diagnosis, measuring, marking out, removing, laying, cutting, fitting, positioning and securing.
Task PB1	Remove and install WCs, sinks, basins, baths and panels
Task PB2	Remove and install taps, washers, waste services, shower trays and valves
Task PB3	Repair and replacement of cistern, ball valve to cold water tank, and syphon
Task PB4	Find and repair leaks in pipework
Task PB5	Unblock wastes, drains, WCs, sink and basins
Task PB6	Installation of laundry appliances, dishwashers

Tasks	Trade Area
Painting and decorating trade skills	
PDCore	Core painting and decorating skills: mixing, pouring, diluting, loading, laying-on, laying-off and cutting-in.
Task PD1	Prepare new or existing background surfaces for painting/decorating
Task PD2	Apply water-borne and/or solvent-borne coatings to internal and external surfaces for linear/trim/narrow-runs and broad areas by brush and/or roller.
Task PD3	Paint room walls and ceilings using emulsion paint
Task PD4	Paint using primer, undercoat and gloss to new installation or repair
Task PD5	Strip wall paper, prepare damaged surface, sand down, filling with wood and mixed filler
Task PD6	Hang wall covering, lining and patterned
Task PD7	Apply damp, mold and fungal wash
Roofing trade skills	
RCore	Core roofing trade skills: measuring, marking out, removing, replacing, fitting, positioning and securing.
Task R1	Remove/repair/replace roof tiles, slates.
Task R2	Remove/repair/replace gutters and pipework, fascias, soffits and barge boards
Task R3	Remove, replace and treat flashings
Task R4	Remove/repair/replace felt, batten and sarking
Task R5	Remove/repair/replace rafters and joist feet
Task R6	Remove/repair/replace roof pointing to verges
Tiling trade skills	
TCore	Core tiling wall and floor surfaces skills: measuring, setting out, cutting, removing, mixing, applying, positioning, securing and finishing.
Task T1	Remove adhesive, remove and replace damaged tiles, remove and renew grout
Task T2	Prepare background surfaces for tiling including stripping/scraping, abrading/keying, hacking, cutting out, filling, levelling/flattening
Task T3	Fix tiles and trims to vertical, horizontal and inclined to wall and floor surfaces, reveals, cills and soffits (door and/or windows)
Task T4	Seal tiles to bath, basin and worktop
Task T5	Remove floor tiles and prepare floor surface
Task T6	Lay floor tiles including scribing, floor drainage and outlets and fixture of appropriate accessories.
Task T7	Screed Floor

6.3 Labour Utilisation Study

In an attempt to compare multi-skilling versus single-trade labour utilisation approaches, an exercise was undertaken by B4Box managers and supervisors on a specific whole-house refurbishment project. Approach A would plan the project to be undertaken by multi-skilled operatives and Approach B would plan the project to be undertaken by single-trade operatives. The same scope of works would be undertaken across the same scope of trades and there would be no subcontractor involvement in either approach. Although it acknowledged there are different types of multi-skilling that could have been planned - for the purposes of the planning exercise, the multi-skilled operatives were assessed to be fully multi-skilled and capable to undertaking all tasks required on the project.

Financial constraints dictated that this task could go no further than being a desktop planning exercise because it would have been commercially unviable to attempt to deliver two similar projects as live experiments using the two different labour approaches. As such the results shown below represent a robust and accurate forecast and are subject to the same caveats as any plan – that the outturn results could have been different on execution.

Table 6.3 breaks down the delivery of the same project using multi-skilled labour and single-trade approaches. The comparison reveals Approach B (8no.) requires double the number of trade operatives to Approach A (4no.), is more expensive and is estimated to take longer. This is because of down-time between different trades and there will be periods with no activity on the site in the handovers between trades. Although the single-trade Approach B requires more staff in total, fewer staff might be on site at any one-time as they come and go to complete one or only a handful of activities.

Approach B also requires double the number of site inductions to be carried by the Project Manager and at different points in time, resulting in additional costs. Each new person requires an orientation period, needs to be given instruction and understand the work that needs doing, whereas, a multi-skilled person working from activity-to-activity across different trades only needs to be inducted once.

In Approach A fewer people are employed but they are on site for a longer duration. The multi-skilled operatives can arrive at the site each morning with continuity knowing exactly where to start working, what needs doing that day and the materials they need. In which case the multi-skilled operatives can load up their vehicle with the correct materials on their way home the night before and they do not need to leave site once they have arrived to visit building merchants and wait for material deliveries before commencing work.

Approach B builds in more costs through additional labour costs, more vans and resulting higher fuel costs. Using Approach B, the Project Manager resource would have to be on site every day, incurring costs, to check progress and make decisions about organising other trades and breaking down work for them. In contrast, using Approach A Project Managers would not incur the same costs because less time is required on site breaking down work, whilst the Project Managers also benefit from more flexibility in planning and the timing of tasks because of the Multi-skilled operatives.

With Approach A there is smooth continuity of work for the multi-skilled operatives and zero idle time, increasing productivity, as they always have work to go at. There is zero disruption to other projects from Approach A as unlike single-trade operatives the multi-skilled employees don't have to be pulled away from other jobs to complete the work, with no transition time between jobs as well.

In terms of the time and cost differences, with Approach A there is integration and quality assurance to sub-processes. Approach B incurs greater costs and time requirements in the snagging phase as

different single-trades must be called back to complete their own snags with delays and knock-on impacts to other projects inevitable. Having multi-skilled operatives on site means they can tackle all snags immediately.

Table 6.3 Comparison of Multi-Skills and Single-Trade Labour Utilisation Strategies

	Approach A: Multi-skill Method	Approach B: Single Trade Method
The number of employees	2 x Multi-skill Operatives and 2 x Multi-skill apprentices (The multi-skill apprentices were not required to complete the work, but were included as part of B4Box's commitment to training and development).	6 x Single Trades plus labourers as follows: 2 x Labourer (rip-out) 1 x Plumber 1 x Joiner 1 x Plasterer 1 x Tiler 1 x Floorer 1 x P&D
Number of site inductions	4 (only 2 if apprentices were not included)	8
Total Project Hours / The length of project duration	136 hours over a 17 day programme	164 hours over a 24 day programme
Labour Costs	£19,200	£25,300
Associated Vehicle and fuel costs	£660	£1,740
Project and Site Manager Resources (£) survey, work schedule, coordinating labour, inductions, managing interfaces between trades, breaking down work for each single trade	£2,200	£4,600
Knock-on financial impact on other projects (having to take labour away from other work)	0	£3,800
Total	£22,060	£35,400

6.4 Benefits of Multi-Skilling to B4Box

The research undertaken at B4Box has revealed multi-skilling is positively perceived. The following findings on the benefits that multi-skilling can produce include opinions in quotations that were collected from qualitative research interviews with different stakeholders.

Reduced planning required: Multi-skill operatives can be assigned to projects by planners who know they can cover multiple tasks across different trades meaning that less time planning and breaking work down for single trades is required, thus producing time and money savings at the company planning level.

“If I have a multi-skill operative I expect to be able to set them up on a job once and for them to do everything from start to finish. You are not reliant on other trades coming in, just dealing with one person, which is cheaper in the long run”. Site Manager

“I can send one man to complete a job and know they will be able to do the job instead of having to plan for a separate joiner, a plasterer, a painter and decorator etc”. Site Supervisor

“Single trades require more planning and management, each with their own van, and you have got to programme in exactly when they need to get there”. Consultant

Improved project cost/time/quality performance: When properly managed, it is possible to gain from multi-skilling by combining activities and constructing the optimum team for specific projects. With a multi-skilled workforce activities can be grouped together according to their sequence in construction processes and planners can assemble a smaller team for a project that can perform all the tasks which can result in positive project outcomes including reduced costs, quicker delivery time and improved quality.

“The list of benefits of having multi-skill employees is endless – we can employ fewer staff and get jobs done with fewer labour hours which helps to keep our labour costs down”. Construction Director

“A good multi-skinner is worth five times more to me than a single trade specialist”. Site Manager

Less supervision required: Multi-skilled employees know the job; less supervision and communication is required because the multi-skill workers can be left to work with a greater degree of trust and autonomy. This leads to quicker decision making and less coordination and organising between trades is required from supervisors.

“If you have a multi-skilled operative on a job from the beginning – it’s like having a working site foreman – they know exactly what needs doing and where the job is up to at any one time and can give me clear updates on progress. This cuts out miscommunication and waiting around for other trades to get there and on with their jobs”. Construction Project Manager

“I trust a multi-skinner to start and finish a job and do everything in between and I know I can leave them to get on with it because there is nothing they can’t do”. Site Supervisor

“From a company point of view it is easier to manage multiple projects at the same time, with fewer labour bottlenecks”. Company Director

Responsibility and support: Multi-skilling helps workers understand more of the project lifecycle and in B4Box’s experience they can take greater responsibility for project delivery and contribute more

hands-on support to project success than single-trade operatives. An explanation for this finding could be how B4Box management handles the employees in practice through the concepts of empowerment, ownership of projects, and seeing things from a wider team perspective, as well as on a basic level multi-skilled workers can just do more to help.

“Multi-skill workers can visualise the complete construction process, being aware of other trades gives multi-skilled operatives a broader understanding of projects and how they can support them effectively including interfaces with other trades”. Construction Director

“Multi-skilling benefits project performance because workers are generally more committed and more productive if someone has made the effort to learn various different trade skills they are more determined and you want them on your jobs”. Site Manager

“It is obvious you will do a better job on the first trade if you know you will be working on the second trade. If you’re putting up a stud wall you will do the best job you can if you know you will then be the person having to plaster it. There is nobody to else blame, you can’t blame the previous trade because you did it”. Site Supervisor

Multi-tasking efficiency: Enables the most efficient use of time, as tasks can be carried in sequence with limited downtime, or even concurrently where appropriate, and potential disruption is avoided through negating handovers between different trades.

“Multi-skilling can allow someone to plaster a wall and then go and fit a door whilst he is waiting for the plaster to dry”. Construction Trainer

“Multi-skilled workers can plan their own work out, and get all the materials supplies they will need for every trade at the same time”. Construction Director

Flexibility and responsiveness: The flexibility in the workforce has enabled us to respond quickly and effectively to market changes and meet new needs from clients in terms of work they require. The increasing pace of change and market uncertainty are major influences to keep multi-skilling at the forefront of our labour strategy.

“If multi-skilling enables a smaller and familiar workforce in our properties, then we are very supportive, this reduces security risks and enables us to build relationships with people”. Construction Client

“They [Multi-skilled workers] allow us to deliver for our clients with smaller labour resources, with a wider spread of skills to support clients demands”. Construction Director

“A multi-skilled workforce allows us to participate in a broader variety of projects, giving us increased flexibility, and we are confident we can tender for work, without relying on supply chain”. Construction Director

“When there is a shortage of staff or an increase in demand site supervisors can reassign multi-skilled workers to meet demand, and help to reduce the demand for additional worker like agency labour”. Site Manager

React to unknown: The use of a multi-skilled teams improves the ability to react and deal with a wider range of situations and unforeseen activities on the site including works technical surveyors might have missed.

“Because of multi-skill workers broader array of skills and they can deal with unforeseen works and problems that occur on site. This is especially useful to repair and maintenance

projects where it is not always possible to forecast the skills and activities that will be required". Construction Director.

"Multi-skilled workers can respond quicker to variations on jobs. For example, when stripping wallpaper and a badly damaged wall is found the multi-skilled worker can repair the wall and then decorate, whereas a painter and decorator might not be able to". Site Supervisor.

Complex problem-solving: Our Multi-skilled workers are better able to diagnose operations problems that involve many trades and respond to any type of situation on site.

"Multi-skilled workers can go around and pick up snags from all trades and will rectify them immediately, this means single-trade specialists don't need to be called out with a delay and pulled away from other work". Site Supervisor

Reduced costs: As well as reduced labour wages driven by the reduced total number of required workers on a project and multi-skilling employees performing a larger portion of the work compared to a single-trade strategy, there are reduced supervision, planning, logistics and transport costs (vehicle and fuel).

"Multi-skilling makes financial sense because as a company we are paying one person instead of two". Finance Director

"There are reduced van and fuel costs, you don't have four or five different guys turning up with their own vehicles". Consultant

6.5 Concerns

In addition to the benefits listed above - various concerns ranging from perceptions, to definitions and assessments, were identified by stakeholders interviewed as part of the interview process.

A recurring issue and frequently raised expression was the stigma of the phrase 'jack of all trades and master of none'. The negative perception of multi-skilling became apparent with even strong champions of multi-skilling acknowledging this to be a key barrier to multi-skilling rollout.

"Multi-skilling is just a bit of something qualification, I don't trust multi-skilling qualifications when planning my labour how do I know if someone can do a trade well or not". Senior Quantity Surveyor (Client)

"Multi-skilling suffers because when the industry is on its knees lots of people go around saying they can do everything to try and pick up any work they can. They get found out and people get the impression multi-skilled workers are just DIYers who are bluffing". Consultant

"There are massive differences in peoples' definitions of multi-skilling. I've met joiners who can paint badly who classify themselves as multi-skilled and but on the other hand I know there are other experienced guys who have taught themselves to do mint work across all trades but they still only call themselves by their single trade". Construction Site Manager.

"Although a particular bloke might be able to do most work, you are still dealing with an individual who has their own opinion and wants to choose what they want to do. So to keep your best staff happy sometimes you have to give some of the simpler tasks to multi-skilled workers which is not ideal". Construction Site Manager

6.6 The Future

There was a broad consensus amongst stakeholders interviewed for this research study that multi-skilling will increase in the future, with many different reasons were suggested:

“This jack of all trades stigma will go over time, more firms will use multi-skilling in the future”. Construction Director

“The way the building trade is going most firms want more multis than single trades”. Site Manager

“It widens employment prospects for people because future employers would prefer to take someone who is flexible and can do a wide variety of work”. Construction Director

“It’s [Multi-skilling] the only way forward. At a previous company specialist joiners and plasterers had completed their work for the day by 1pm. They were being told to pick up some other skills to get full pay. Over the long term those that failed to learn new skills or were unwilling to do other work were the first ones to be let go”. Site Manager

“I would not advise a young person coming into construction that they will be able to forge a long-term career as a single trade in this day and age”. Site Supervisor

“As someone who is now a supervisor when I started my apprenticeship I was only given an opportunity to learn a single trade, I wish I had the opportunity to do everything. I would have grabbed it with two hands and that would have enabled to become competent at an earlier stage”. Site Supervisor

“Multi-skillers are not stuck to one trade so can pick up work quicker or set-up a firm for themselves”. Consultant

“As a multi-skinner you have the chance to work for yourself or do foreigner jobs outside of work to earn extra cash and the beauty is that you don’t have to get other people involved. If you worked for yourself as a joiner and to price for kitchen you need to know what to charge for a plasterer subcontractor, a tiler, a decorator, maybe a plumber and this would eat into your earnings”. Site Manager

“As a multi-skinner you don’t have to pay other people to do work on your house, you can turn your hand to anything to do up your own properties and help out family and friends”. Site Foreman

“The biggest difference over the last 40 years has been the quality of materials available which really supports multi-skill working because you no longer need to be a technical specialist to do pick the basics of each trade, and this makes multi-skilling much easier now and into the future”. Consultant

“I would to say to newcomers do multi-skilling from a young age and you will have a head start, you will know how to do them all properly and rather than just having one job you can do you could have twenty different ones”. Site Foreman

“To any new person thinking about multi-skilling I would say you should jump at it, pick it all up, the multi-skill qualification will push you more, and it is harder work, but you get on further and its good for your future”. Site Supervisor

7. Conclusions and Future Research

This research has demonstrated that multi-skilling can produce benefits to individuals and companies. Individual construction operatives can gain economic benefits because of increased earning potential, increased employment durations and continuity of work. For firms, multi-skilling can increase productivity and the quality of work whilst reducing costs and timescales. Using B4Box as a case study, the research and development undertaken here shows that multi-skilling is a feasible strategy for our business model.

However, several impediments and limitations to multi-skilling implementation do exist such as high training costs and industry resistance to change. Asking operatives to undertake additional activities without ensuring that they have the skills to carry them out competently risks failure. Therefore, the support of different stakeholders, such as training organisations, employers and workers will be essential to successful implementation of multi-skilling. If this can be achieved multi-skilling can become a key solution to overcoming strategic industry challenges and a driver of the future development of the construction industry.

It is recommended that further research, that requires cooperation from different stakeholders including training organisations, employers and operatives, is undertaken to create new knowledge on the impact of multi-skilling and provide guidance on the optimum extent of multi-skilling as follows:

- > **Rigorous measurement and analysis of results:** create methodologies to robustly measure the productivity impact of multi-skill strategies, model the cost/benefit analysis and the return on investment of multi-skilling initiatives.
- > **Sector contexts:** Explore the costs and benefit of multi-skilling utilisation strategies across different sectors of the construction industry and types of projects. For example, are advanced labour management systems required to manage a multi-skilled workforce in non-repair and maintenance construction sectors?
- > **Trade combinations:** Explore the number and type of trades that can be combined. How many trades are sufficient for different job roles and what is the effect of using specific combinations of trades? How can multi-skilling be optimised? For example, Radley's (2015) suggestion to focus on the combination of in-depth skills in one particular function - with strong understanding of the adjacent key skills that complement it.
- > **Assessing and qualifying competency:** Research and investment in training, monitoring and a support systems for multi-skilling will be essential for it to succeed. The balancing of competing objectives from different stakeholders is required to produce a sustainable system for the training, assessment and qualification of multi-skilling. The current delay in multi-skilling moving from an apprenticeship framework to apprenticeship standard compared to single trades illustrates the complexity involved. To ensure multi-skilling is not put in the too-difficult-to-do box a concerted effort is required to research and develop (a) new training packages designed around business need, (b) the support infrastructure required to ensure workers have the time and opportunity to learn, and (c) appropriate assessment procedures to evaluate and validate multi-skill proficiency.
- > **Implementation of multi-skilling on projects and in firms:** Production of good practice materials and how-to guides to support construction firms in their planning and implementation of multi-skilling construction management strategies. This should include how to overcome barriers, engage operatives, make decisions on how far multi-skilling should

be diffused in firms i.e. throughout the workforce or a certain percentage of it, and ensure its ongoing sustainability through initiatives like employee multi-skilling records, on-the-job training and workplace-based assessments of competence.

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