Industry Briefing Paper

Information & Communication technology (ICT) in the Australian Construction industry

"A Case in Point Investigation of ICT Uptake"

Results of a national survey investigation into the implementation and uptake of information and communication technology (ICT) in the Australian construction industry.

TARGET:

The investigation targeted three broad areas:

- **Current ICT status** including annual ICT investment, access to and use of ICT devices according to annual turnover;
- **ICT training** including training participation by individuals, training support within respondent organisations with regards to workload and time flexibility for employees, preferred mode of training for individuals, and level of ICT competence expectations of the various construction project participants of their colleagues; and
- **ICT trends and opinions** on the Benefits/Drivers and Barriers/Limitations to the implementation and use of ICT on construction projects.

A survey was implemented on a national basis within the construction industry - including non-building, building (commercial/industrial), and residential sub-sectors - with a view to informing the decision makers within the construction industry on ICT policy relating to:

- The types of ICT being used across the construction industry sub sectors and for various project sizes to enable them to identify possible improvements through ICT uptake;
- The preferred mode of training amongst construction industry employees allowing them to implement suitable ICT training regimes for employees; and
- The benefits/drivers and barriers/limitations to the uptake of ICT on construction projects to enable them to identify suitable ICT implementation strategies within their organisations.

RESPONDENT PROFILE

Respondents where asked to answer specific questions to enable detailed comparative analysis of the responses. In terms of a general profile, the analysis revealed that:

- 92% of respondents were from the East Coast of Australia;
- 78% of respondents have some form of Tertiary Qualification;
- 71% of respondents were in some form of managerial role within their organisation;
- All respondents had greater than 1 year and 54% had at least 10 years service in their present position;
- 63% of respondents were from a contracting organisation and 29% were from a consultant/specialist organisation with the remaining 12% being spread between Supplier and Client organisations;
- The majority (74% of those who knew the organisation's annual turnover) of respondents organisations had annual turnover's of less than $5M and 10% of respondents organisations had annual turnover's of $100M+ or greater; and
- At least 80% of respondents were from the Vertical/Building construction sub-sector.

SURVEY POPULATION

The population for the survey was defined as members of the Australian Construction Industry in 2003 however; the sample frame was limited to those known to have an IT capacity. It was believed that the sample frame would be representative of the general population. In all 467 potential respondents were emailed informing them how they were chosen for the survey, who is carrying out the research and the research objectives. Data collection was completed by 14th November, 2003.

MOST SIGNIFICANT OBSERVATIONS FROM THE SURVEY RESULTS

'Annual turnover has an effect on the uptake of ICT and training performance in ICT for an organisation."

Effects of budget on Uptake and Current ICT Status:

- In general, higher ICT investment was observed for higher annual turnover organisations;
- In general, higher ICT investment, hence annual turnover organisations, had a higher rate of use and access to emerging or innovative ICTs such as Handheld and Tablet computers, Video Conferencing and Wi-Fi devices; and
- The most significant Barrier/Limitation to the implementation or use of ICT on projects was budget constraints.

Effects of Budget on ICT Training:

- Lower turnover construction organisation respondents were less likely to have undergone ICT training;
- Lower turnover construction organisations were less supportive of ICT training through flexible workload and time allocation; and
- Higher turnover organisations had a greater preference for the professional consultants' mode of training and conversely, lower turnover organisations had a greater preference for self learning.

Technical Issues:

Interoperability (incompatibility) and not having an ICT professional on site or within ready access were found to be strong influential Barriers to the uptake of ICT on projects for most respondents. When investigating results according to sub-sector, several of the groups were found to rank highly issues that were not in the top five as a sample group. For example, the Non-building and Residential groups ranked their demanding and inflexible workloads as being in their top 5 Barriers to uptake of ICT for projects.

Driver for ICT Uptake:

The overriding driver for ICT uptake for respondents was to improve their operational performance through improved productivity at both the personal level and the organisational /team level. Improved business opportunity was also highly influential for respondents. Similar results to these were found on investigation of results according industry sub-sectors. However, interestingly the Residential sub-sector rated the driver of improved business opportunities higher than the other two sub-sector groups.

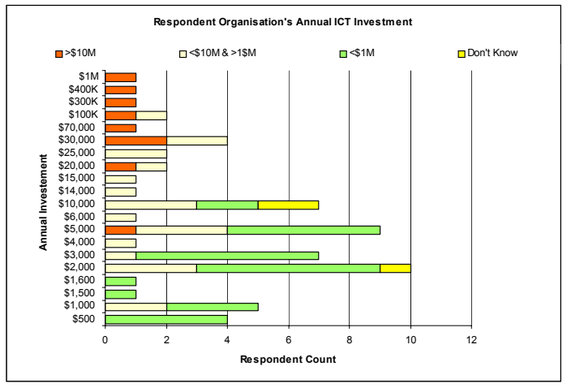
CURRENT ICT STATUS

This section investigates the respondents and respondent's organisations where appropriate, current ICT status including:

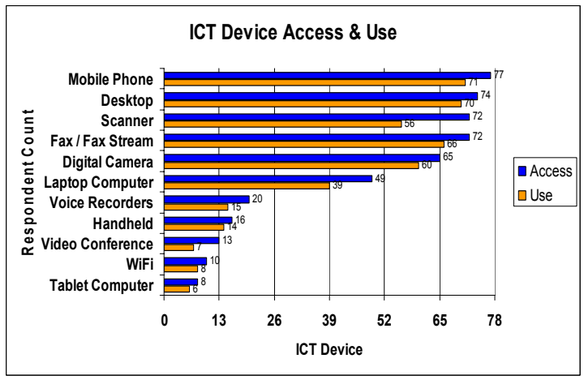
- ICT organisational investment: including further analysis of ICT investment according to sub-sector and annual turnover; and
- ICT device access and use: including use and access for various devices, access and use of emerging/innovative technologies by annual turnover.

ICT Organisational Investment

The annual amount spent on ICT investment varied considerably from $500 to $1,000,000 with the most frequent amount specified being $2000. The factors expected to be influential on ICT investment included annual turnover and the industry sector.



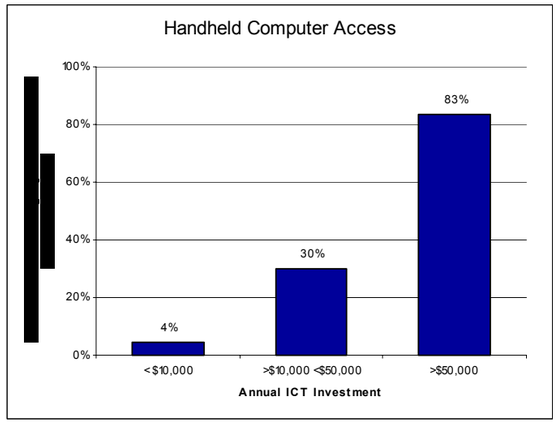
ICT Device Access & Use



Respondents were asked to identify which ICT devices, from a specified range, they have access to within their company and subsequent to this, which of these devices they used on a range of project sizes.

The list provides a range of ICT technologies, some ICT technologies such as Desktop computer, Mobile phone, Scanner, Fax and Digital camera are established technologies and according to the responses are accessible by most respondents. Based on the responses, these technologies are widely used on construction projects.

When considering emerging technologies such as Wi-Fi, Handheld and Tablet computers, and Video Conference equipment, the analysis revealed that the amount of annual ICT investment of the companies apparently impacts on accessibility. Organisations with higher investment budgets have a higher proportion of these emerging technologies. This is illustrated in the adjoining figure which displays the distribution of access to handheld computers according to the ICT investment category. This chart shows that 83% of the respondents with an annual ICT investment budget greater than $50,000 have access to handheld computers compared with only 4% of those with an ICT budget of less than $10,000. A similar pattern is revealed when analysing technology usage for other emerging technologies.



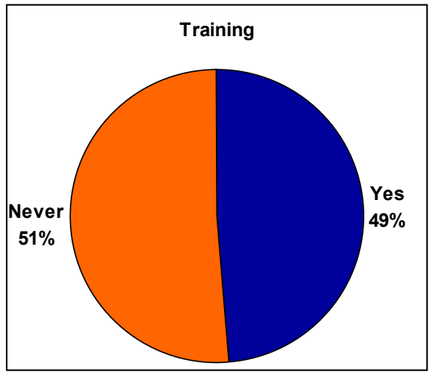
ICT TRAINING

Also investigated were the ICT training characteristics of the respondents and respondent's organisations including:

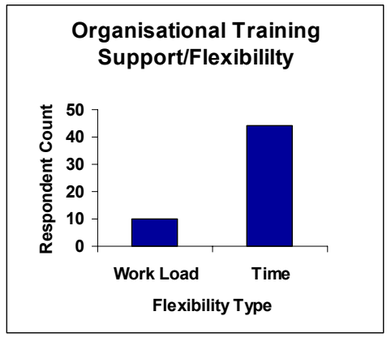
- Official ICT training participation - including overall participation, participation considering annual turnover, and participation variability in the sub-sector groups;
- ICT training company support - including whether the respondents were allowed time or workload flexibility to undergo ICT training, sub-sector analysis was also completed;
- ICT training mode preference - including analysis dependent on annual turnover ranges;
- ICT competence expectations - including respondent's expectations dependent on sub-sector group.

ICT Training Participation

Respondents were asked to indicate whether they had undergone any official ICT training. Almost half (49%) of the respondents indicated they had undergone official training. When comparing responses by the company classification, Sub-contractors were more likely to have never undergone official training. Larger ($100M+ turnover) organisations had a higher proportion of respondents indicating they had undergone official training.



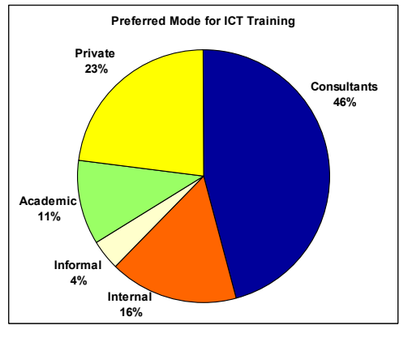
Company Support for ICT Training



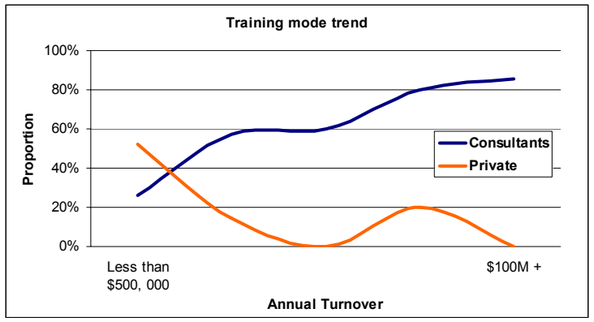
Over half of the respondents indicated their company did allow them sufficient time during office hours to undergo ICT training. Respondents were also asked whether their company adjusted/reduced their workload to undergo ICT training - with only 10 respondents indicating their company did adjust/reduce their workload. Interestingly, 6 of those were from companies with a turnover range between $1M - $5M.

ICT Training Mode Preference

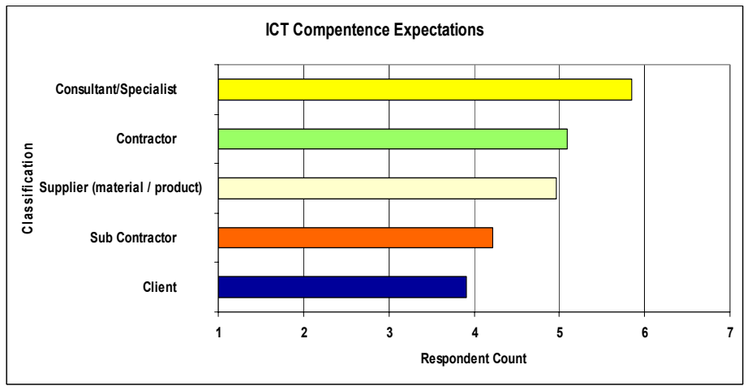
The respondents were asked to nominate their preferred mode of training from a selected list. The preferred training mode was with professional consultants, with 46% of respondents nominating this method.



The training mode preference trend indicated below shows the response trend for preferred mode of training dependent on the respondent's turnover classification. The chart shows an increasing preference for professional consultants as the annual turnover category increased. 86% of respondents from the higher turnover categories indicated a preference for training mode with professional consultants compared with the lower turnover categories, where 52% indicated a preference for private training.



ICT Competence Expectation



Respondents were asked to indicate what overall level of ICT competence (capabilities, skills, etc) they believed specific team members should have on a project. Overall respondents expect the consultant to have a greater level of ICT competency than all other team members. Contractors and Suppliers were rated next with Clients and Sub-contractors rated lowest however, still expected to have at least average competence.

When comparing the responses dependent on the role of the respondent it was apparent that those in managerial roles tended to expect a higher competency from all team members than did other groups. When comparing responses based on the respondent class, Sub-contractors tended to expect a greater level of competency from Sub-contractors in general than did other groups. They also expected a higher level of competency from Contractors than other groups.

ICT TRENDS & OPINIONS – BENEFITS, DRIVERS, BARRIERS, LIMITATIONS

The investigation also examined trends and opinions as to the benefits or drivers and the barriers and limitations to the implementation or use of ICT on construction projects.

Benefits/Drivers for ICT on Projects

Respondents were asked to indicate what influence a specified range of Benefits/Drivers has on their decision to implement or use ICT on projects.

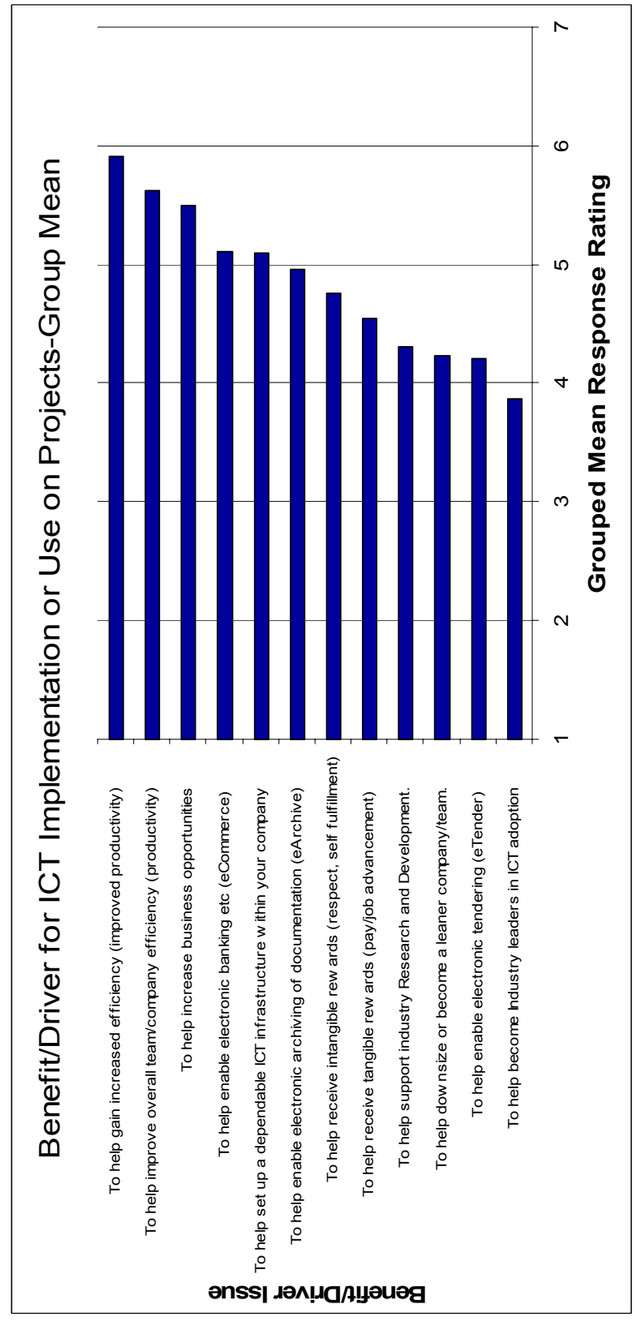
The mean response rating for most issues was above average suggesting that most issues were influential in their decision to implement or use ICT on projects. The only issue with a below average mean response was '*To help become Industry leaders in ICT adoption*'.

The chart shows the issue with the highest mean rating was '*To help gain increased efficiency (improved productivity)*' followed by '*To help improve overall team/company efficiency (productivity)*' and '*To help increase business opportunities*'.

The issues found to be of least influence, in order of influence include *'To help become industry leaders in ICT adoption'; 'To help enable electronic tendering (eTender)';* and *'To help downsize or become a leaner company/team'*.

Essentially, respondents perceive ICT to provide productivity Benefits to their project operations, both at the individual and team/company level. They also perceive some strategic Benefits in the way of improved business opportunities that the ICT may provide.

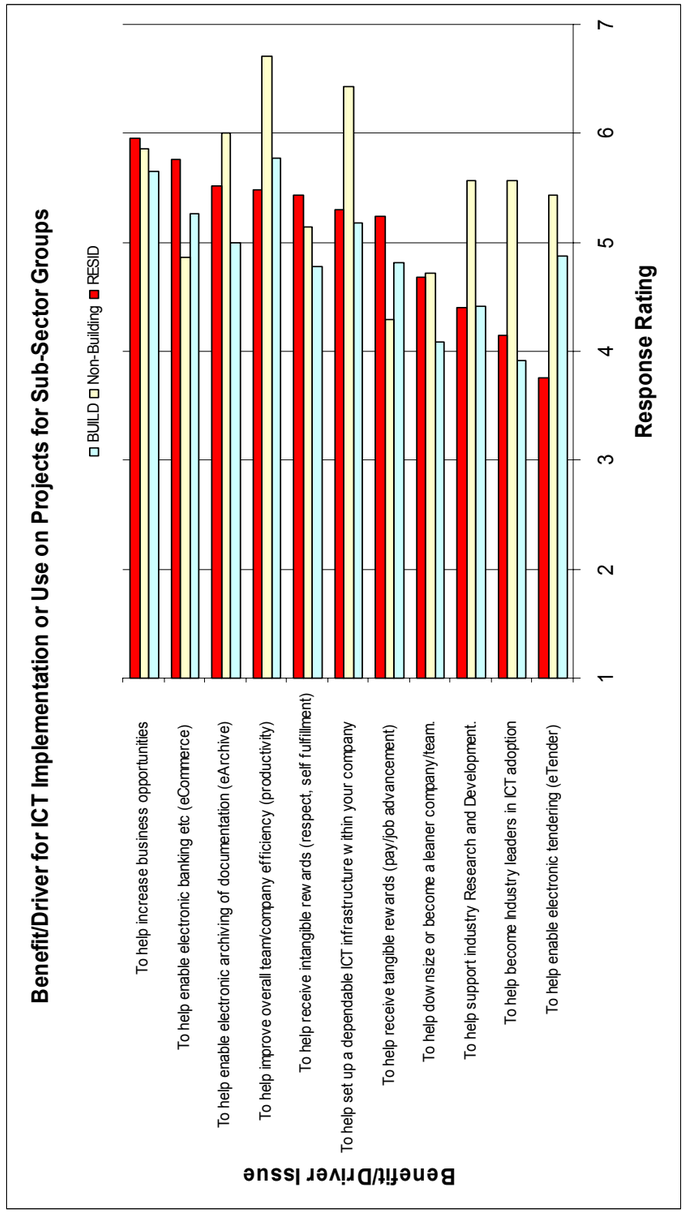
The Non-building sub-sector respondents perceived *'To help improve overall team/company efficiency (productivity)'* and *'To help gain increased efficiency (improved productivity)'* as the most influential Benefits/Drivers respectively to ICT implementation or use on projects. Other issues, which have a strong influence for the Non-building sub-sector respondents, in order of influence are *'To help set up a dependable ICT infrastructure within your company'; 'To help enable electronic archiving of documentation (eArchive)';* and *'To help increase business opportunities'*.



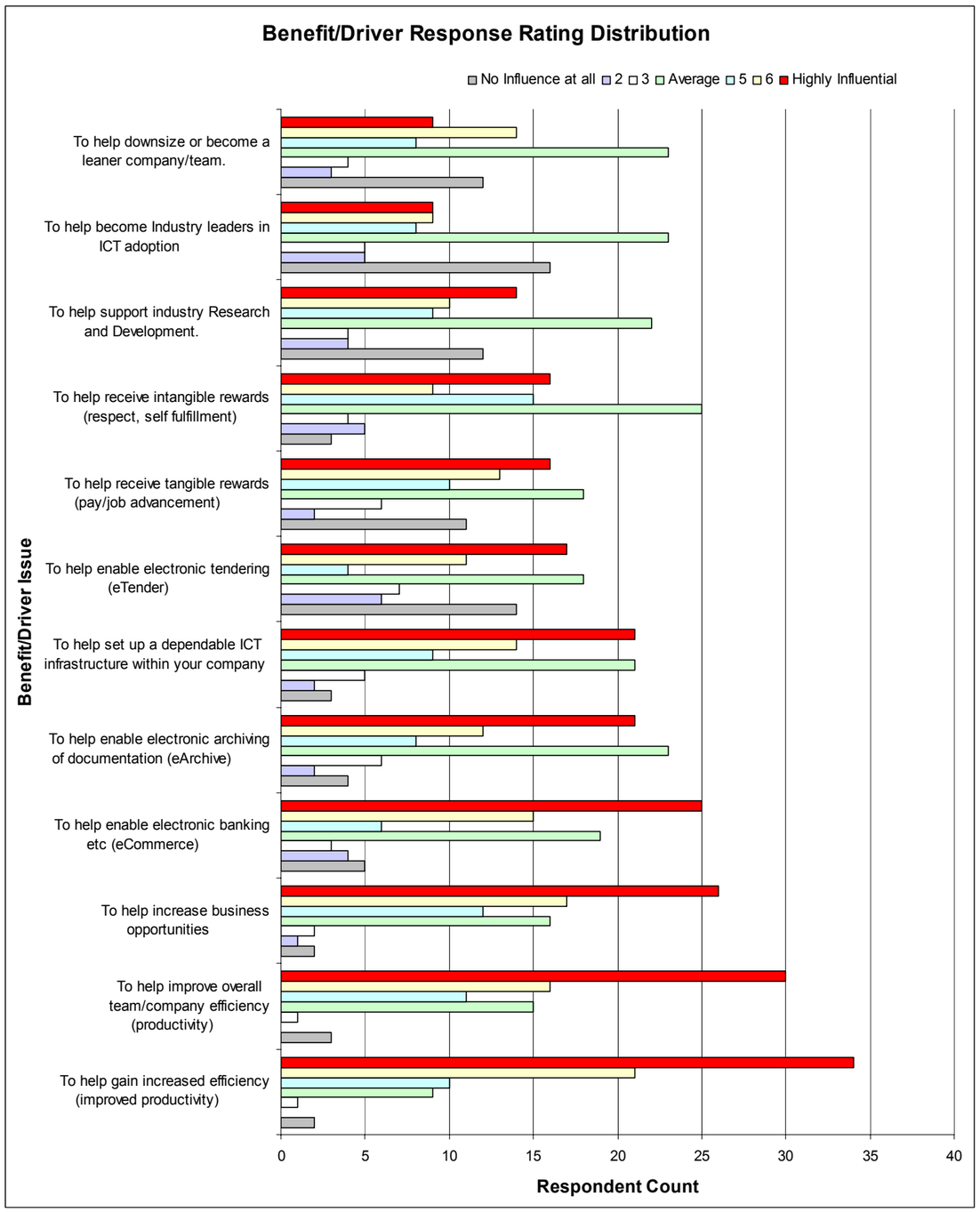
It is worthy of note that those in the Non-building sub-sector indicated that "*To help set up dependable ICT infrastructure'* was more influential than "*To help increase business opportunities*" where the overall mean response showed a different result.

Building construction (Commercial/Industrial) respondents perceived '*To help gain increased efficiency (improved productivity)'* and '*To help improve overall team/company efficiency (productivity)'* as being the most influential Benefits/Drivers respectively to implementing or using ICT on projects. Other issues, which have a strong influence for Building construction sub-sector, in order of influence are *'To help increase business opportunities'; 'To enable electronic banking etc (eCommerce)';* and *'To help set up a dependable ICT infrastructure within your company'*.

The **Residential** sub-sector respondents perceived '*To help gain increased efficiency (improved productivity)'* and *'To help increase business opportunities'* as their most influential Benefits/Drivers respectively to ICT use and implementation on projects. Other issues, which have a strong influence for the Residential sub-sector, in order of influence are *'To enable electronic banking etc (eCommerce)'; 'To help enable electronic archiving of documentation (eArchive)';* and *'To help receive intangible rewards (respect, self fulfilment)'*.



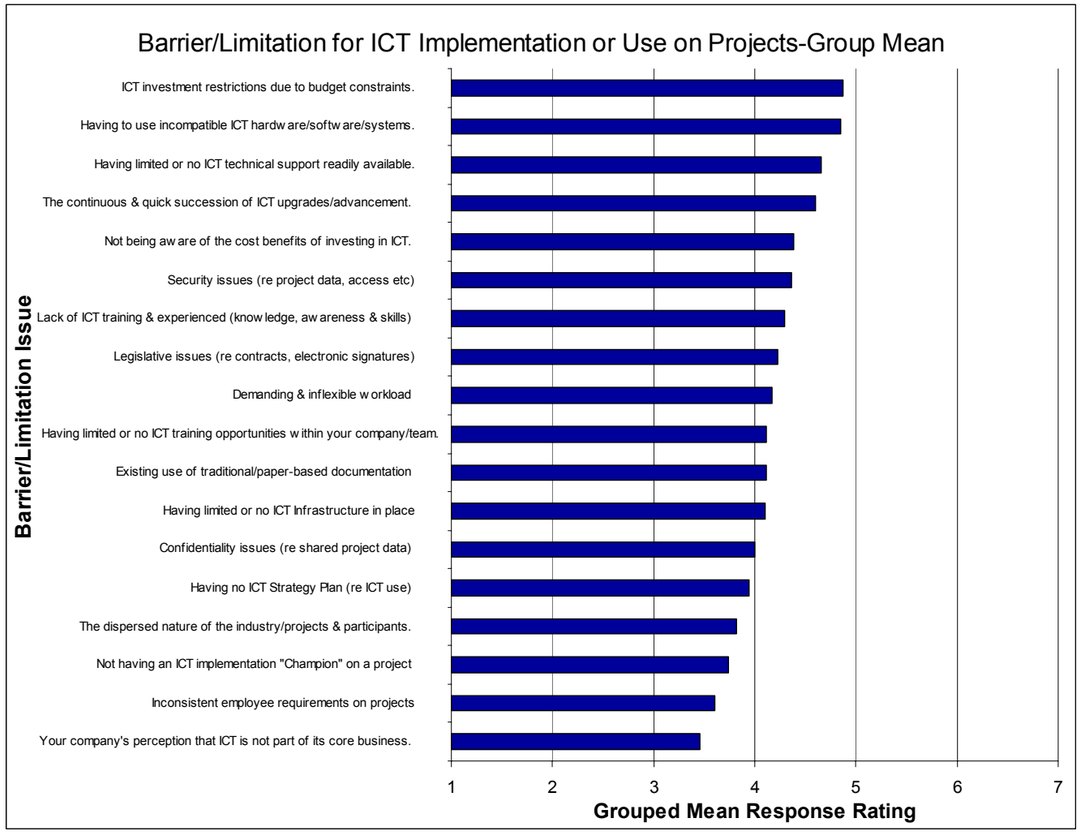
It is interesting to note that the **Residential** sub-sector rated the increase in business opportunity Benefit/driver as more influential than the other sub-sectors. Another interesting result for Residential sub-sector is the relatively high influence rating, compared to the group mean, for the issue '*To help receive tangible rewards (pay/job advancement)*'. It is also interesting to note that the issue '*To help enable electronic tendering (eTender)*' had less influence for those in the Residential construction sub-sector than the other two.



Barriers/Limitations for ICT on Projects

Respondents were also asked to indicate what influence a specified range of Barriers/Limitations has on their decision to implement or use ICT on projects.

The chart shows that all issues are grouped between slightly-below to slightly-above average influence and that '*ICT investment restrictions due to budget constraints*' was most influential. Technical issues such as '*Having to use incompatible ICT hardware/software/systems*', '*Having limited or no ICT hardware/software support readily available*' and 'The continuous & *quick succession of ICT upgrade/advancement*' were the next most influential Barrier/Limitations issues when considering to implement or use ICT on projects.



The issues found to be of least influence, in order of influence include: *'Your company's perception that ICT is not part of its core business'; 'Inconsistent employee requirements on projects'; and 'Not having an ICT implementation "Champion" on a project'*.

Non-building construction respondents perceived *'Having limited or no ICT technical support readily available'* and '*Demanding and inflexible workload'* to be equally the greatest Barriers/Limitations influencing their decision to implement or use ICT on projects. Other issues, which have a strong influence for this sub-sector, in order of influence were *'Having limited or no ICT training opportunities within your company/team'; 'Having to use incompatible ICT hardware/software/systems';* and *'Having limited or no ICT infrastructure in place'*.

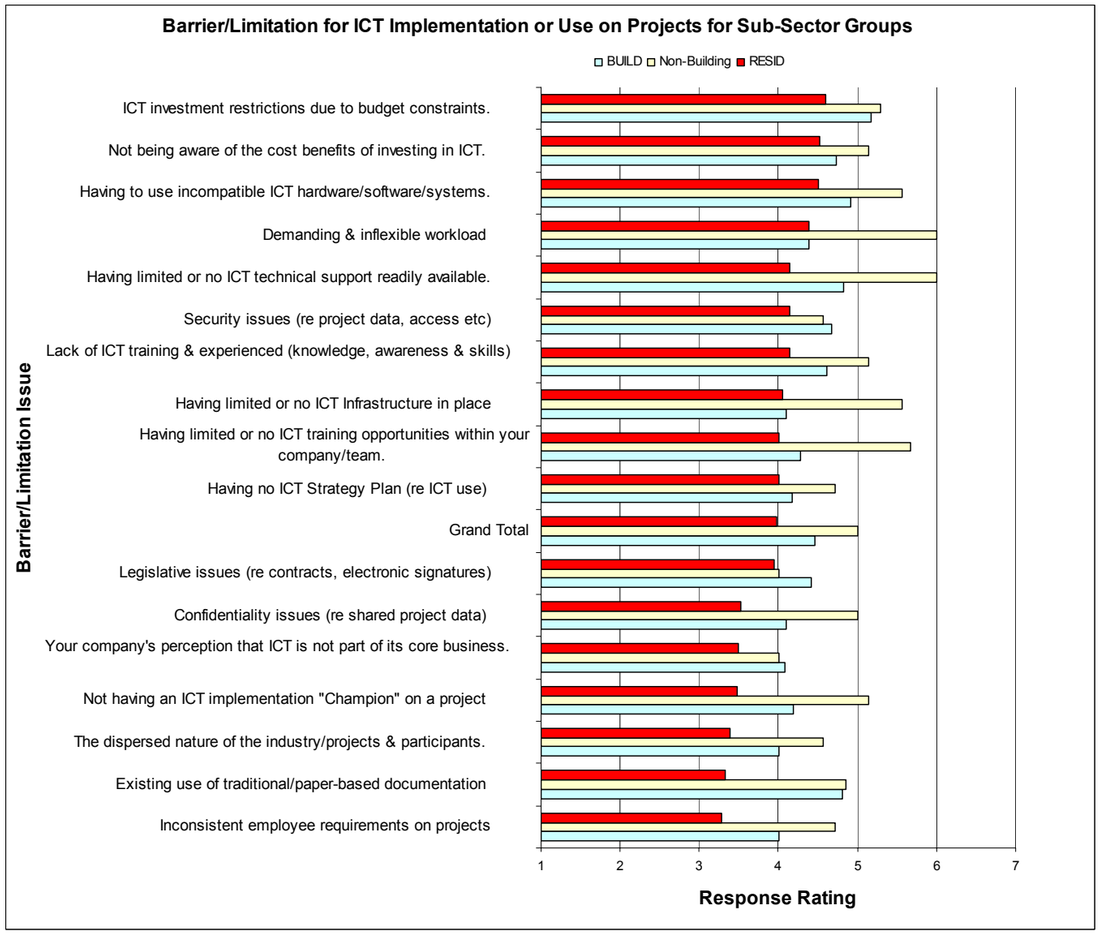
It is interesting to note that '*ICT investment restrictions due to budget constraints'* was not as highly influential for this sub-sector than for the other two. This may be as a result of the relationship between ICT investment and annual turnover, where results indicate that a large percentage (86%) of the Non-building sub-sector respondent organisations were in the high (greater than $5M) annual turnover ranges.

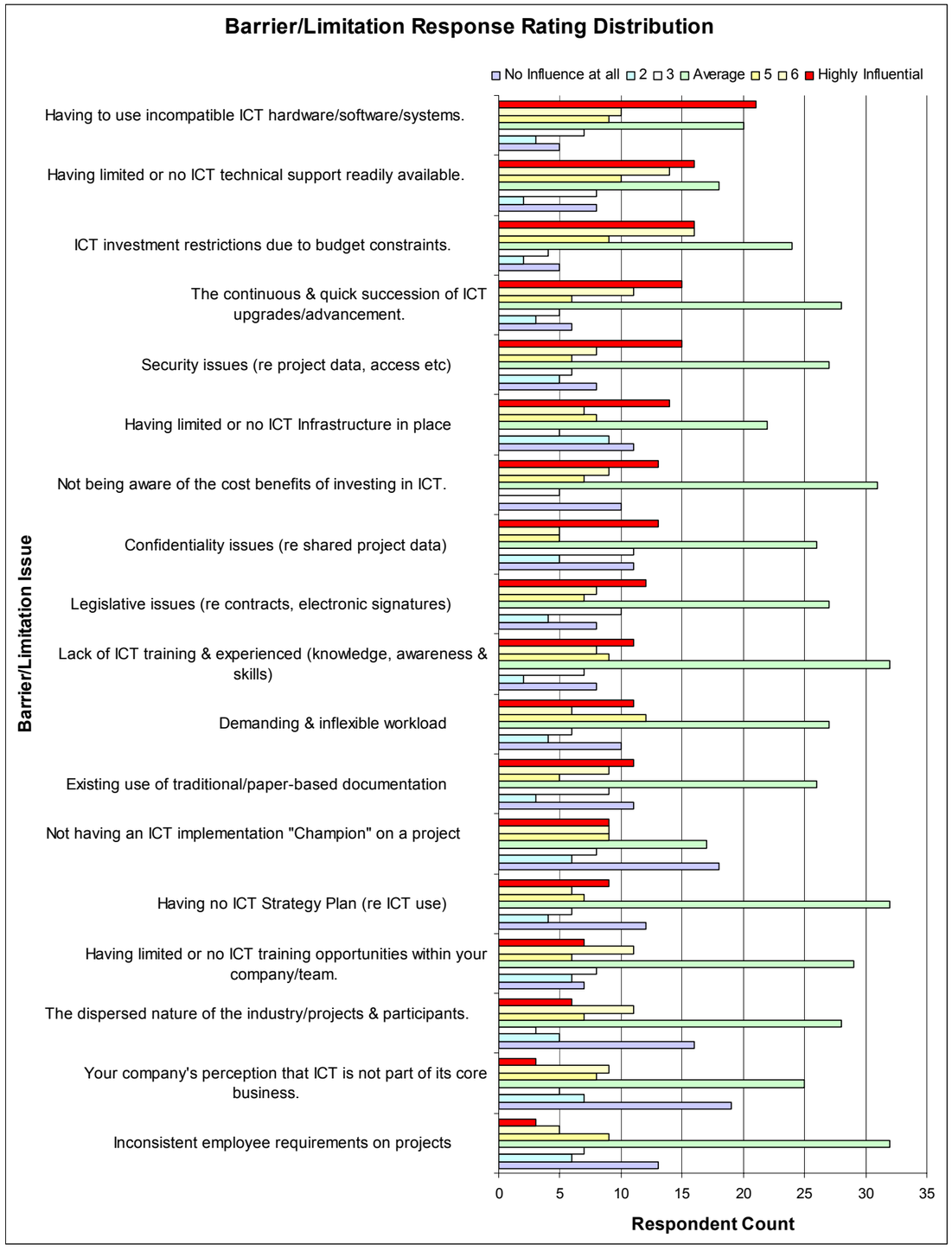
It would appear they typically have more money to invest, hence their lower perceived restriction on budgets for ICT, and their tendency to be more innovative. All of the issues presented were perceived by the Non-building sub-sector to be at least an average influential Barrier/Limitation to ICT implementation or use on projects.

The relatively high influence of '*Having limited or no ICT training opportunities within your company/team*' is an interesting result due to the fact that all respondents in this sub-sector indicated that they are allowed sufficient time during office hours to undergo official ICT training.

Building construction (Commercial/Industrial) respondents perceived '*ICT investment restrictions due to budget constraints*' and '*Having to use incompatible ICT hardware/software/systems'* as being the most influential Barriers/Limitations respectively to implementing or using ICT on projects. Other issues, which have a strong influence for this sub-sector, in order of influence were *'Having limited or no ICT technical support readily available'; 'Existing use of traditional/paper based documentation';* and *'The continuous & quick succession of ICT upgrades/advancement'*.

The **Residential** sub-sector respondents perceived *'The continuous & quick succession of ICT upgrades/advancement'* and *'ICT investment restrictions due to budget constraints '* as their most influential Barriers/Limitations respectively to ICT use and implementation on projects. Other issues, which have a strong influence for this sub-sector, in order of influence were *'Not being aware of the benefits of investing in ICT'; Having to use incompatible ICT hardware/software/systems';* and *'Demanding and inflexible workload'*.





The table below summarises the results of the most influential Benefit/Driver issues for respondents.

Group	Benefit/Driver Influence Ranking				
	1	2	3	4	5
Total Mean	*To help gain increased efficiency (improved productivity)*	*To help improve over all team/company efficiency (productivity)*	*To help increase business opportunities*	*To help enable electronic banking etc (eCommerce)*	*To help set up a dependable ICT infrastructure within your company*
Non-building	*To help improve overall team/company efficiency (productivity)*	**To help gain increased efficiency (improved productivity); and* **To help set up a dependable ICT infrastructure within your company*		*To help enable electronic archiving of documentation (eArchive)*	*To help increase business opportunities.*
Building	*To help gain increased efficiency (improved productivity)*	*To help improve overall team/company efficiency (productivity)*	*To help increase business opportunities*	*To help enable electronic banking etc (eCommerce)*	*To help set up a dependable ICT infrastructure within your company*
Residential	*To help gain increased efficiency (improved productivity)*	*To help increase business opportunities*	*To enable electronic banking etc (eCommerce)*	*To help enable electronic archiving of documentation (eArchive)*	*To help receive intangible rewards (respect, self fulfilment)*

* Both had same influence and tied for second.

The table below summarises the results of the most influential Barrier/Limitation issues for respondents.

Sub-sector	Barrier/Limitation Influence Ranking				
	1	2	3	4	5
Total Mean	*ICT investment restrictions due to budget constraints*	*Having to use incompatible ICT hardware/software/systems*	*Having limited or no ICT technical support readily available*	*The continuous & quick succession of ICT upgrades/advancement*	*Not being aware of the cost benefits of investing in ICT*
Non-building	**Having limited or no ICT technical support readily available; and* **Demanding and inflexible workload*		*Having limited or no ICT training opportunities within your company/team*	*Having to use incompatible ICT hardware/software/systems*	*Having limited or no ICT infrastructure in place*
Building	*ICT investment restrictions due to budget constraints*	*Having to use incompatible ICT hardware/software/systems*	*Having limited or no ICT technical support readily available*	*Existing use of traditional/paper based documentation*	*The continuous & quick succession of ICT upgrades/advancement*
Residential	*The continuous & quick succession of ICT upgrades/advancement*	*ICT investment restrictions due to budget constraints*	*Not being aware of the cost benefits of investing in ICT*	*Having to use incompatible ICT hardware/software/systems*	*Demanding and inflexible workload*

* Both had same influence and tied for first.

FUTURE SURVEYS

Researchers recommend the distribution and analyses of similar surveys are to be repeated periodically (eg every two years) so that changes, advancements, shift, etc. of ICT uptake within the Australian construction industry can be observed.

Further Information:

Further detail on the recommendations and guidelines can be found in report 2001-008-C-08 "A National Perspective on the Status of ICT in the Australian Construction Industry" and 2001-008-C-09 "Recommendations and Guidelines: To help Improve ICT Integration within Today's AEC Industry" from the CRC Construction Innovation Project 2001-008-C "Project Team Integration: Communication, Coordination and Decision Support"

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