

Economic analysis of proposed change to Tower Crane Code of Practice

Report prepared for the Queensland Office of Industrial
Relations



Adept Economics

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Cover photo

A luffing crane (on the left) and Tower Crane (on the right) in Milton, Brisbane. Photo taken by Jennifer Tunny.

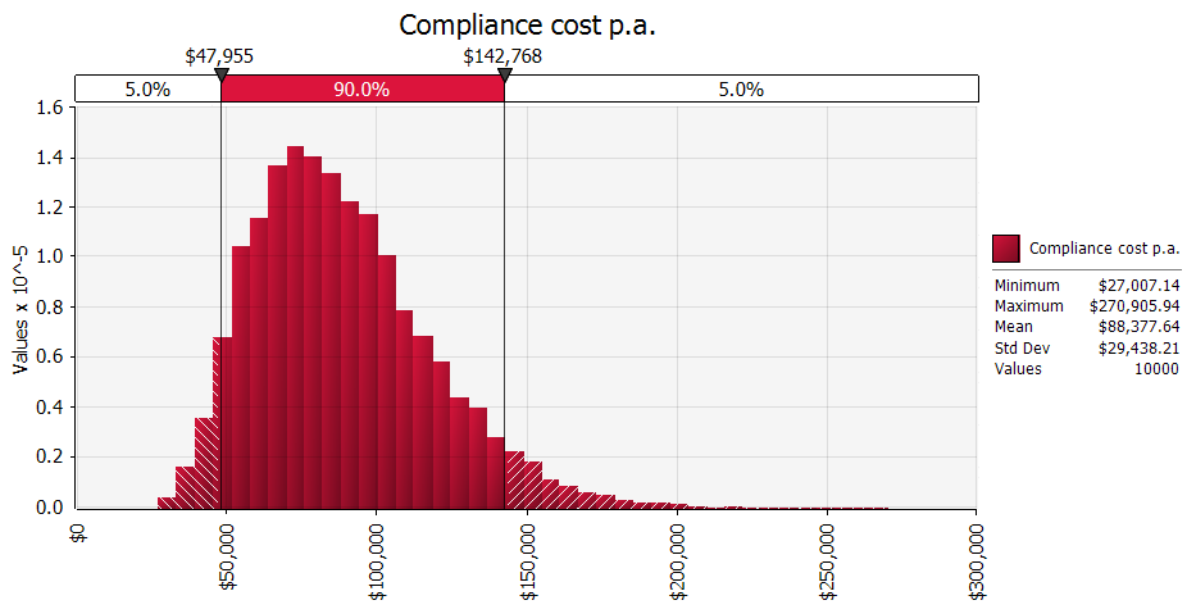
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Summary

- The Review of Tower Crane Code of Practice has recommended the code be amended to require third party inspections of tower cranes when tower cranes are commissioned. Currently, the Code only requires that such an inspection is carried out by a competent person, rather than an independent third party such as a CraneSafe inspector.
- Economic analysis based on survey data reveals that the total annual compliance cost resulting from the proposed change to the code of practice is expected to be around \$75,000, but could range from approximately \$48,000 to \$143,000 (Figure S1).

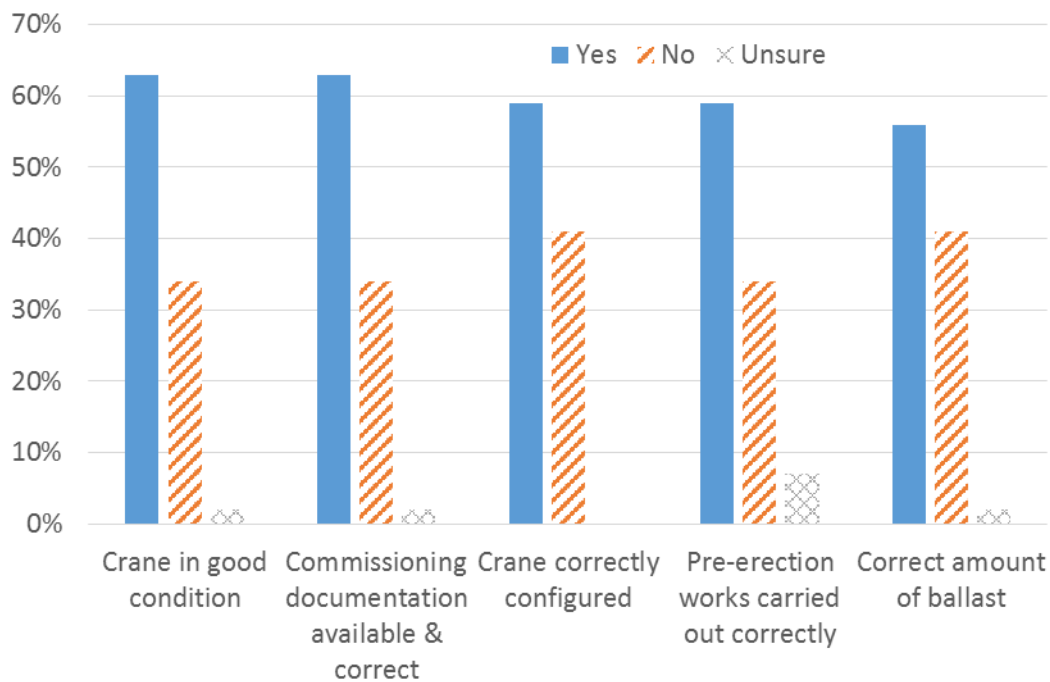
Figure S1. Estimated range of compliance cost per annum estimate



Source: Adept Economics, 2016. Monte Carlo analysis conducted using @RISK.

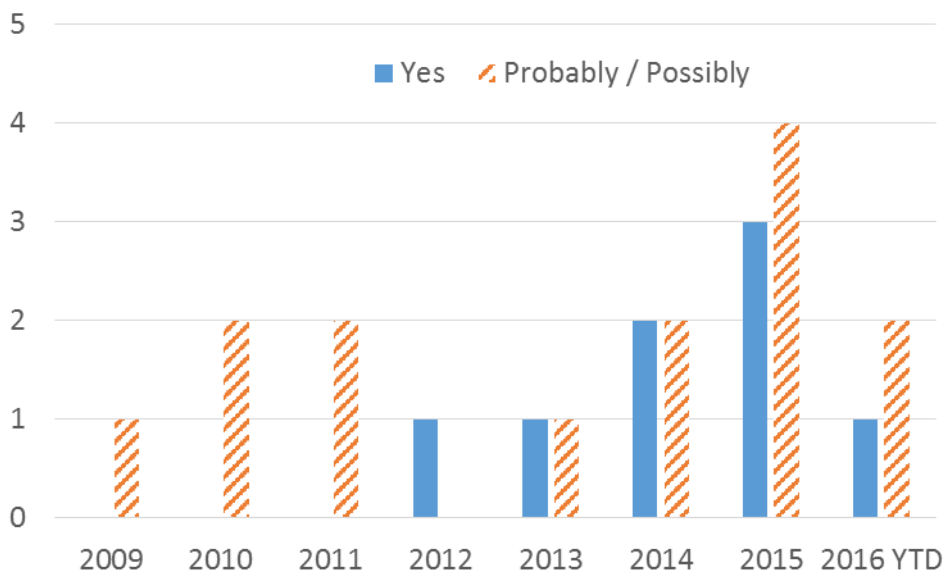
- The possible benefits of changes to the code of practice were confirmed by the survey of crane owners, with a solid majority (63 percent) agreeing that third party inspections would enhance safety. Third party inspections are expected by a majority of owners to increase the likelihood of a range of important factors relating to safety (Figure S2 over the page).
- Analysis of data on workplace incidents found several incidents were identified where a third party inspection could have avoided potentially dangerous issues, and hence there may well be significant community benefits in the proposed change to the tower crane code of practice (Figure S3 over the page). The frequency of incidents that could have been avoided increased markedly in 2014 and 2015, no doubt associated with the ramp up in residential construction activity.
- Given the potentially large cost of incidents that could occur if a tower crane is incorrectly set up, it may well be desirable to amend the Code of Practice as proposed, particularly given the higher levels of construction activity Queensland has seen recently.

Figure S2. Survey respondents' view on whether third party commissioning inspections would improve particular safety aspects of tower cranes, Queensland, June 2016



Source: Adept Economics, 2016, based on survey data.

Figure S3. Whether a potentially dangerous tower crane incident could have been avoided by a third party inspection at the commissioning stage, frequency, Queensland



Source: Adept Economics analysis of OIR data in consultation with [redacted] from OIR. [redacted]

1. Introduction

The Office of Industrial Relations (OIR) has commissioned Adept Economics to undertake an economic analysis of a proposed change to the Tower Crane Code of Practice. This report presents the results of that economic analysis.

2. Background

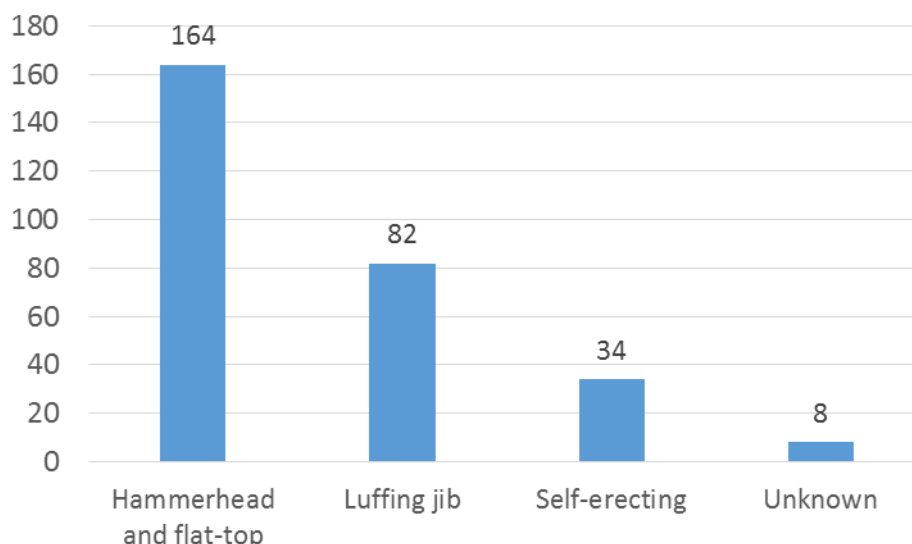
What is a tower crane?

A tower crane is a particular type of crane, with a boom or a jib mounted on a tower structure.¹ They can be distinguished from mobile cranes, for example. There are several different types of tower cranes, including:

- Luffing;
- Hammerhead and flat top; and
- Self-erecting (which are operated by remote control).

As at June 2016, there were 288 registered tower cranes in Queensland, based on OIR plant registration data. Examination of the crane make and model numbers registered reveals that hammerhead (and flat-top) cranes are the most numerous, followed by luffing jib cranes and a much smaller number of self-erecting cranes (Figure 1). In a small number of cases the crane type could not be identified from information in the database.

Figure 1. Registered tower cranes, Queensland, June 2016



Source: OIR, 2016.

Each type of tower crane has its own advantages and disadvantages relative to the others, and hence no one tower crane type is preferred for all applications. For example, luffing cranes tend to be used in the CBD because they require less clearance, while hammerhead cranes tend to be used in suburban developments because they are less noisy and more cost-effective. Hammerhead and flat

¹ Safe Work Australia, 2015, *Guide to Tower Cranes*.

top cranes typically have electric motors, while luffing cranes have either diesel or electric motors.

Review of tower Crane Code of Practice

The Review of Tower Crane Code of Practice has recommended the code be amended to require third party inspections of tower cranes when tower cranes are commissioned. Currently, the Code only requires that such an inspection is carried out by a competent person, rather than an independent third party such as a CraneSafe inspector.²

The requirement would mean that an independent third party inspector such as a CraneSafe Assessor would prepare a Pre-Erection and Commissioning report. For a luffing jib tower crane, for example, this is a four page report which captures basic data regarding the crane (e.g. owner, type of crane) and includes:

- a checklist of 35 pre-erection inspection items (e.g. cab & mountings, condition of ballast, load indicators) requiring the assessor to tick that the items are either “OK” or not applicable (“NA”) to that crane;
- a checklist of 24 commissioning inspection items (e.g. all brake functions, isolation switch, emergency stop, load moment cut outs); and
- a section to record the result of commissioning tests undertaken by the crane operator, including a 10 percent dynamic overload test and a 24 percent stability overload test.

The requirement for independent third party inspections would introduce additional costs to industry, particularly the:

- cost of the third party inspection itself (e.g. the fee for a CraneSafe assessor); and
- opportunity cost of holding up work on the site while waiting for the inspection to be completed.

The possible benefits to the community of introducing a requirement for mandatory third party inspections would need to be considered in light of these costs, which are estimated as part of the economic analysis presented in this report.

3. Potential cost to the community of changing the code of practice

In assessing the impact of the code, it is only additional costs to the community that are relevant. To the extent that industry is already having third party inspections undertaken at commissioning stage, the change to the requirement would not impose an additional cost. Hence it is important to understand the following:

- the current incidence of third party inspections; and
- the cost of third party inspections.

Regarding the incidence, members of the Tower Crane Code of Practice Steering Committee consulted believed the incidence was very high at around 80-90 percent. It was considered that

² Also, OIR has asked for advice regarding the possible cost of a compulsory third party inspection each year a tower crane is on site.

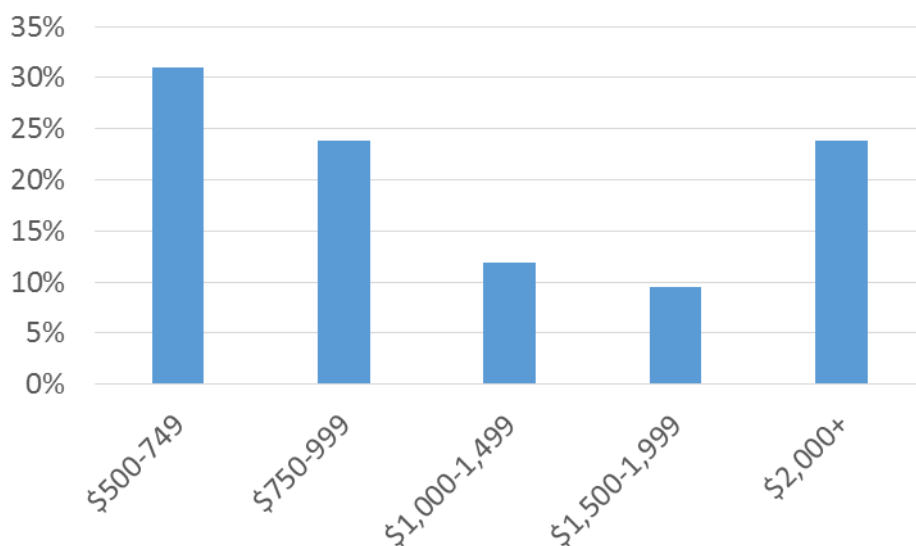
major builders would always require a third party inspection, and that it would be smaller builders on sites in the suburbs who would not require one. Regarding the likely cost, there was considerable variation in estimates, ranging from \$500 to \$2,000, with \$800 a typical estimate.

It was decided by OIR that key data on the incidence and cost of third party inspections would be obtained from a survey of crane owners. Adept Economics drafted the survey questions in consultation with OIR (See Appendix 1). A phone survey of tower crane owners was conducted over June and July 2016 by Q&A Market Research (acting as a sub-contractor to Market & Communications Research). Ultimately the survey had 41 respondents, out of a population of 54 crane owners in Queensland.

Key survey findings

There was significant variation in the reported cost of third party inspection of cranes at commissioning stage (Figure 2). While the median cost lies between \$750-999, a significant proportion of cranes cost more than \$2,000 to inspect. These cranes are typically of larger capacity and require longer to inspect.

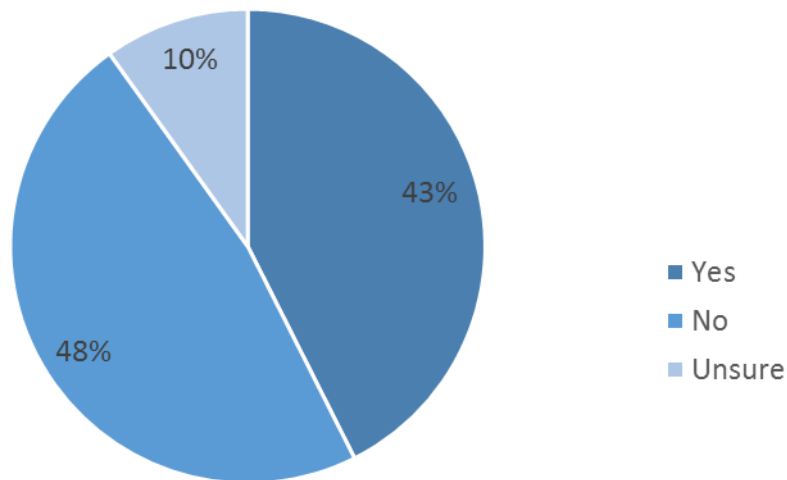
Figure 2. Estimated cost of last inspection at commissioning stage, frequency (%)



Source: Crane owner survey data reported in MCR, 2016. N.B. weighted by number of cranes owned.

Additional costs from delays associated with third party inspections were also identified by over two-in-five respondents who get third party inspections (Figure 3). These additional costs were estimated at \$3,333 on average for all companies, ranging from \$1,813 for construction companies and \$4,094 for equipment hire companies, on average.

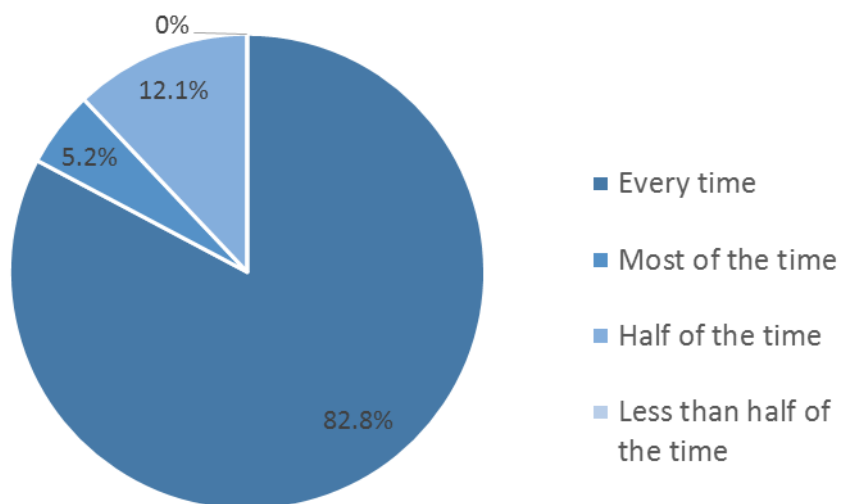
Figure 3. Percentages of respondents reporting additional costs through impacts on work timeframes and resulting delays



Source: Crane owner survey data reported in MCR, 2016.

As noted above, a change in the code of practice to require third party inspections would only impose additional costs on the community in cases where cranes are not already being subject to third party inspections. As suspected based on prior information, the survey revealed that a very high proportion of cranes are being subject to third party inspections at the commissioning stage already.

Figure 4. Frequency of third party inspection at commissioning stage



Source: Crane owner survey data reported in MCR, 2016. N.B. weighted by number of cranes owned.

Compliance cost estimation assumptions

Based on the survey and data from OIR on registered cranes, assumed parameters of the costing model, including minimum and maximums for a Monte Carlo sensitivity analysis, were specified (Table 1).

Table 1. Compliance cost estimation assumptions

	<i>Parameter</i>	<i>Base value</i>	<i>Minimum</i>	<i>Maximum</i>
A	Number of tower cranes	288	n.a.	n.a.
B	Proportion of cranes not currently subject to third party inspections	10%	5%	20%
C	Cost of inspections	\$875	\$500	\$3,000
D	Percentage of cases in which other costs incurred	50%	40%	60%
E	Other costs (i.e. through impacts on work timeframes and delays)	\$3,300	\$1,500	\$4,000
F	Cranes for which no commissioning event occurs in any year	10%	5%	20%
G	Average number of times cranes are commissioned per annum	1.2	1.0	1.5
H	Hours of staff time to undertake inspection at commissioning stage (i.e. where no third party inspection)	1.0	0.5	2.0
I	Hourly cost of staff time (incl. on-costs)	\$90	\$75	\$200

Source: Adept Economics, 2016, based on survey data, OIR data, ABS data, and consultations.

Compliance cost estimates

Based on the above assumptions, the total annual compliance cost across all crane owners of changes to the Tower Crane Code of Practice would be equal to around \$75,000 p.a.³ This compliance cost relates to the relatively small number of commissioning events where currently no third party inspection takes place, estimated at 30-35 events per annum based on the assumptions in Table 1 which were derived from the survey data. The cost per commissioning is equal to the cost of the inspection, assumed to be \$875 on average, and the cost of any impacts on work timeframes, equal to around \$3,300 on average in the approximately 50 percent of cases where these impacts occur. The compliance cost estimate takes account of the partially offsetting savings in the costs of time for the employees who would undertake inspections in cases where third-party inspections do

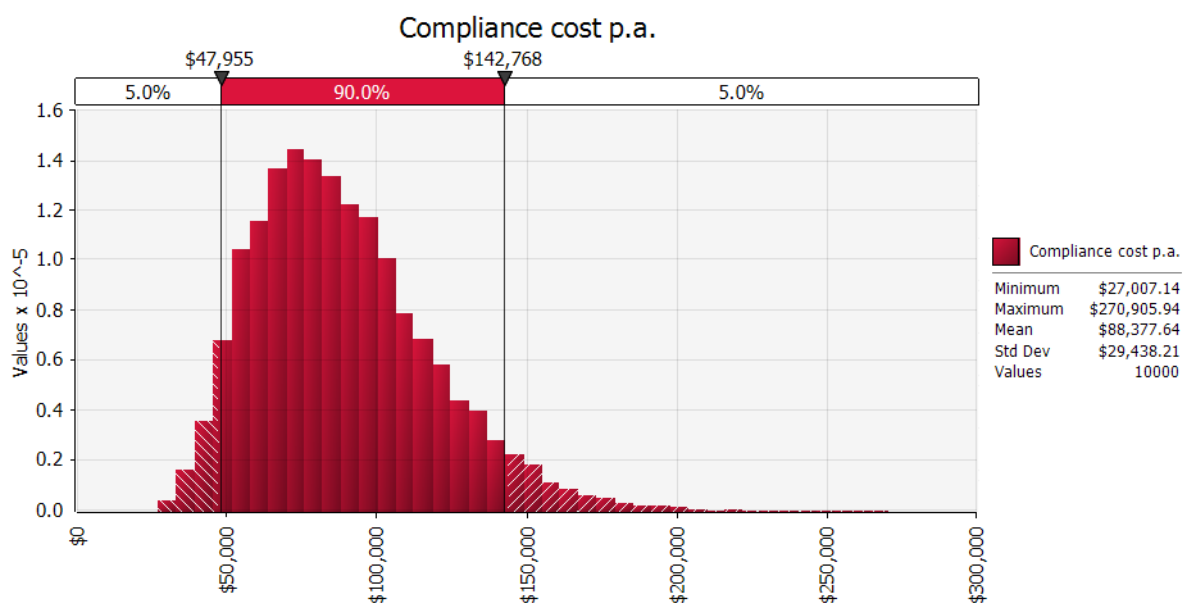
³ This is approximation to the estimate of \$75,738 which can be calculated from the table above using the formula $B*(1-F)*A*G*(C+D*E-H*I)$, applied to the base values in Table 1.

not occur (see rows H and I in Table 1).

To understand the possible variation in the total compliance cost that could occur due to uncertainty, a Monte Carlo sensitivity analysis was undertaken using the @RISK add on package to Microsoft Excel. The parameters in Table 1 were assumed to be distributed according to the PERT distribution, which is a popular distribution in Monte Carlo analysis, as it can take on an asymmetric shape. This is important where there is more upside risk to cost estimates than downside risk, for example. The PERT distribution for each parameter is defined using the base value and minimum and maximum values set out in Table 1.

The Monte Carlo analysis revealed that the annual compliance cost of the change to the Code of Practice to require compulsory third party inspections for tower cranes at commissioning stage is between \$47,955 and \$142,768 with 90 percent confidence (Figure 5). Note that this is based on the current number of cranes and the cost range would increase over time as the population, economy, construction activity and the number of tower cranes grow.

Figure 5. Monte Carlo analysis of compliance cost p.a., based on 5,000 random draws



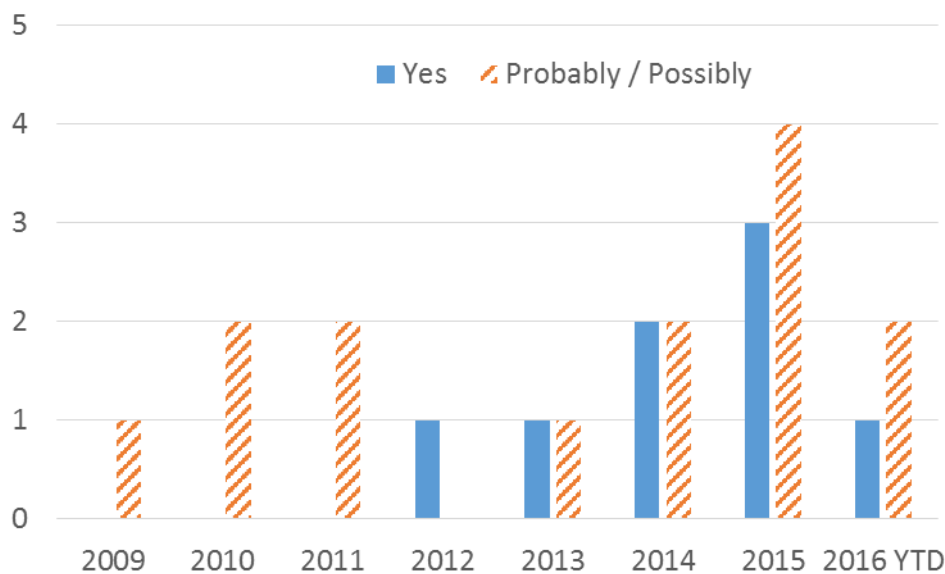
Source: Adept Economics, 2016. Monte Carlo analysis conducted using @RISK.

There would be additional compliance costs if the Code were also required to require annual third party inspections—i.e. where the crane is still on the same site in the same position after one year has elapsed. The survey data suggest that this could affect approximately half of the tower cranes in Queensland, meaning it could potentially impose an additional compliance cost of over \$360,000, given that it is not expected that annual third party inspections are being conducted on tower cranes at the moment. This would be additional to the estimated total compliance cost of requiring third party inspections at commissioning of around \$75,000. This change to the Code could have a much greater impact than only requiring third party inspections at the commissioning stage.

4. Benefits of changing the code of practice

While a quantification of the likely benefits of the change to the code of practice is outside the scope of the study, narratives of incidents involving tower cranes over the last seven years were studied to determine whether there were issues that a third party inspection may have picked up at commissioning stage.⁴ This analysis was intended to determine whether the proposed Code of Practice change would reduce the risk of potentially catastrophic incidents involving tower cranes. Several incidents were identified where a third party inspection could have avoided potentially dangerous issues, and hence there may well be significant community benefits from the proposed change to the Code of Practice (Figure 6). The frequency of incidents that could have been avoided increased markedly in 2014 and 2015, no doubt associated with the ramp up in residential construction activity, particularly of apartment towers.

Figure 6. Whether a potentially dangerous tower crane incident could have been avoided by a third party inspection at the commissioning stage, frequency, Queensland



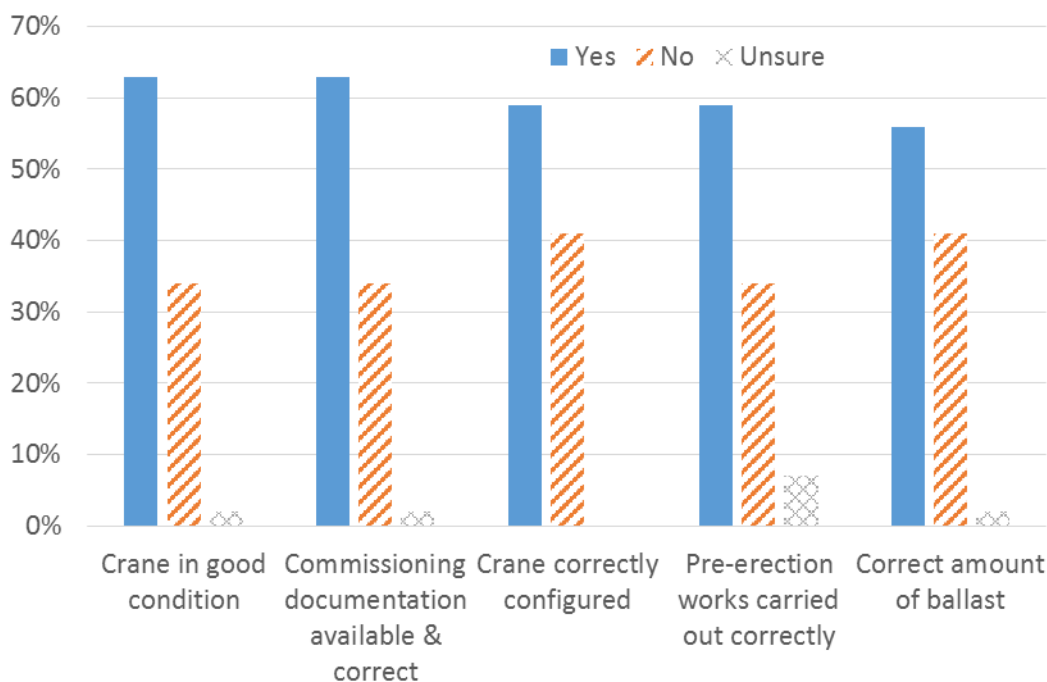
Source: Adept Economics analysis of OIR data in consultation with [REDACTED] from OIR. [REDACTED]

The possible benefits of changes to the code of practice were confirmed by the survey of crane owners, with a solid majority (63 percent) agreeing that third party inspections would enhance safety.⁵ Third party inspections are expected by a majority of owners to increase the likelihood of a range of important factors relating to safety, including cranes being in good condition, being correctly configured, and having the correct amount of ballast (Figure 7).

⁴ Data were obtained from the CISr database of incidents notified by inspectors which is maintained by OIR's Data and Evaluation Branch. The search terms "tower" and "crane" were used to identify possibly relevant records. A first pass of the data was made by Adept Economics, identifying incidents which may have involved an issue relating to inadequate commissioning. Adept Economics then consulted with OIR's Senior Principal Advisor (Construction Engineering) regarding whether identified issues could have been avoided by a third party inspection.

⁵ Market & Communications Research, 2016, *Survey of Tower Crane Owners: Graphical Debrief*, p. 11.

Figure 7. Survey respondents' view on whether third party commissioning inspections would improve particular safety aspects of tower cranes, Queensland, June 2016



Source: Adept Economics, 2016, based on survey data.

Several respondents to the survey provided comments on the safety benefits of third party inspections:

“You need someone independent to give you the full picture, a truthful accurate report on the situation of your crane. It’s a good idea.”

“I think it’s a good idea. The more people that get inspected the safer it will be.”

“A lot of it comes down to the individual operators. I guess if it saves one accident then it is worth it.”

However, as the survey results in Figure 7 indicate, a minority of respondents did not believe requiring third party inspections would improve safety. Comments from survey respondents included:

“You guys are over-regulating to the point where construction companies are not going to wear the cost of these inspections. You are ignoring far more pressing issues like dog-men touching live loads, which there is no legislation for currently.”

“I have invested a lot of money in the guy who currently conducts my inspections to make sure he is competent. No one can question his level of competency so I don’t see why I have to pay extra. We pride ourselves on safety.”

So, while a majority of respondents see safety benefits from the proposed change to require third party inspections at the commissioning stage, the change would not be universally supported.

5. Conclusion

The economic analysis has found that the total annual compliance cost resulting from the proposed change to the code of practice is expected to be around \$75,000, but could range from approximately \$48,000 to \$143,000. What may appear to be a relatively small compliance cost to the industry is due to the already very high incidence of third party inspections at crane commissioning.

The annual additional cost to individual owners not currently getting third party inspections would range from under \$1,000 to several thousands of dollars, depending on the number of cranes they own, the size of the cranes, and whether a third party inspection would impose delay costs through impacting on work timeframes.

Given the potentially large cost of incidents that could occur if a tower crane is incorrectly set up, and noting that incident data suggests there have been several “near misses” in recent years, it may well be desirable to amend the Code of Practice as proposed, particularly given the higher levels of construction activity Queensland has seen recently. For example, it is expected that third party inspections would significantly reduce the risk of incidents where tower cranes collapse or parts of cranes fall off, endangering workers and possibly members of the public. Finally, a majority of industry members believe that third party inspections would improve safety through increasing the likelihood that cranes are in good condition and are correctly configured.

Appendix 1. Survey of tower crane owners

Preamble

I am contacting you on behalf of Workplace Health and Safety Queensland in relation to a review of the Tower Crane Code of Practice 2006. As you know, tower cranes* (common types are luffing, hammerhead and self-erecting) are required to be registered with Workplace Health and Safety Queensland as items of plant. We are contacting you as we are advised that you currently have tower cranes registered with Workplace Health and Safety Queensland.

The Government is currently considering changes to the Tower Crane Code of Practice to ensure the Code reflects current regulatory requirements, appropriate safety standards and best industry practice.

One of the changes being considered is to introduce a requirement for independent third party inspections of tower cranes at the commissioning stage. This would involve ensuring that a competent person who is independent from your company and others involved in the construction project carries out a full inspection of the crane when it is commissioned. If your company already gets an independent party to inspect the commissioning of the tower crane, there is no additional requirement. This survey is designed to gather information about how such a requirement would affect the tower crane industry.

Questions

1. What best describes the nature of your business?

- Construction company
- Equipment hire company
- Manufacturing or engineering company
- Other _____

2. Which of the following types of tower cranes does your company have, and how many (approximately)? (Note that, by a tower crane, we mean a crane with a boom or jib crane mounted on a tower structure. This does not include mobile or franna cranes.)

- Hammerhead or flat top _____
- Luffing (with electric motor) _____
- Luffing (with diesel motor) _____
- Self-erecting _____

3. How is/are the crane/s identified used?

- Hired out to other companies
- Used on your own company's building sites
- Used on own company's sites (but not on building sites) and in a permanent fixed position
- Used on own company's sites (but not on building sites) and moved around from time-to-time

4. How often do you engage independent third party inspections at the commissioning stage of your tower cranes? (please answer for each type of crane you have identified above)

Flat top or hammerhead cranes

- Always
- Most of the time
- Half of the time
- Less than half of the time
- Never

Luffing cranes (electric motor)

- Always
- Most of the time
- Half of the time
- Less than half of the time
- Never

Luffing cranes (diesel motor)

- Always
- Most of the time
- Half of the time
- Less than half of the time
- Never

Self erecting

- Always
- Most of the time
- Half of the time
- Less than half of the time
- Never

5. a) Thinking about the last time you had a tower crane commissioned and inspected by a third party, how much did you pay for the third party inspection at the commissioning stage?*** (Do not ask this question if they have answered in question 4 that they never have a tower crane inspected by a third party.)

- <\$500
- \$500-750
- \$750-1,000
- \$1,000-1,500
- \$1,500-2,000

- \$2,000+

b) What type of tower crane was this?

- Hammerhead or flat top
- Luffing (with electric motor)
- Luffing (with diesel motor)
- Self-erecting

c) What is the lifting capacity of the crane in question?

6a. Does an independent third party inspection have any other additional costs through impacts on work timeframes and resulting delays (compared with an inspection by someone working for your company)?

- Yes
- No
- Unsure

6b. If Yes, what would you estimate these costs are each time a tower crane is commissioned? (Do not include the cost of inspection.)

- <\$500
- \$500-1,000
- \$1,000-2,000
- \$2,000-5,000
- \$5,000+

7. On average, how many times per year would one of your tower cranes be commissioned and hence require a third party inspection (due to the change to the Code of Practice being considered)?

8. On average, how many of your cranes would be on-site at one location for more than one year?

9. In your opinion, do independent third party inspections increase the likelihood that:

- | | | | |
|---|-----|----|--------|
| ▪ Crane is correctly configured and safety features are operating (e.g rated capacity limiters are fitted and correctly calibrated) | Yes | No | Unsure |
| ▪ Crane is in good condition | Yes | No | Unsure |
| ▪ Commissioning documentation is available and correct | Yes | No | Unsure |
| ▪ Pre-erection works are carried out correctly | Yes | No | Unsure |
| ▪ Correct amount of ballast is used | Yes | No | Unsure |

10. In your opinion, would third party inspections enhance safety on work sites?

- Yes

- No
- Unsure

11. Do you have any comments on the proposed requirement for third party inspections?

*under the Work Health and Safety Regulation 2011, a ‘tower crane’ means a boom crane or a jib crane mounted on a tower structure. A self-erecting tower crane means a crane that is not disassembled into a tower element and a boom or jib element in the normal course of use, and where erecting and dismantling processes are an inherent part of the crane’s function.