

# Business Resilience and Recovery following the Canterbury Earthquakes

## Disruption Factors

*Results Bulletin 2018-5*

Findings from a survey of 206 organisations in the Greater Christchurch Urban area in mid-2016.

### Question

Which infrastructure and non-infrastructure disruptions

- a) Impacted the highest number of respondents
- b) Had the most severe impacts

following the Canterbury earthquakes.

### Findings

#### ***Infrastructure***

Infrastructure service outages causing the highest number of respondents (over 60%) to experience some disruption were: Phone networks, Road Networks, Electricity, Data Networks, and Water. The severity of impact of infrastructure disruption was highest from road networks, phone, electricity and water.

#### ***Non-Infrastructure***

The non-infrastructure issues causing the highest number of respondents (60% or more) to experience some disruption were, Changes in staff emotional wellbeing, Customer issues, Damage to local neighbourhoods, Structural damage to building, Non-structural damage to building and Perceptions of building safety. The severity of impact of non-infrastructure was highest from customer issues, changes in emotional wellbeing, difficulty accessing premises and structural damage to buildings.

## Results

### Infrastructure

An average weighted score was calculated based on the level of disruption experienced from the outage of various infrastructure. Weightings used were 0 for *not disrupted*, .33 for *slightly*, .66 for *moderately* and 1.0 for *very disrupted*. The weighted averages shown in Table 1, include all respondents who responded by actively evaluating level of 'disruptiveness' to their organisation, rather than indicating they had *no loss of service or not applicable* (refer Approach section below). Further details about disruption calculation justification can be found in Giovinazzi et al (2016) [www.inderscienceonline.com/doi/abs/10.1504/IJCIS.2016.081303](http://www.inderscienceonline.com/doi/abs/10.1504/IJCIS.2016.081303)

As can be seen in Table 1, on average, Road network issues presented as the most substantial disruption, closely followed by issues with Phone networks, Electricity and Water. The lowest levels of disruption were generated by interruptions to the services provided by Rail networks, Gas, Port and Airport. Data in Table 1 are sorted by mean weighted disruption score from highest to lowest and reflects a ranked list of infrastructure impacts affecting the business community in the Canterbury district. Numbers of organisations who experienced the disruption are also included in the table.

**Table 1: Average (mean) weighted disruption scores for outages of infrastructure items (all respondents).**

<b>Impact to organisation from disruptions to:</b>	<b>Mean weighted disruption</b>	<b>Number experiencing disruption</b>
<i>Road Networks</i>	0.59	134
<i>Phone networks</i>	0.53	141
<i>Water</i>	0.50	114
<i>Electricity</i>	0.50	118
<i>Sewage</i>	0.48	95
<i>Data Networks</i>	0.44	116
<i>Fuel</i>	0.24	60
<i>Airport</i>	0.11	27
<i>Port</i>	0.10	22
<i>Gas</i>	0.08	15
<i>Rail Networks</i>	0.06	13

Table 2 contains the proportions of organisations **that reported experiencing some level of disruption** (i.e. *slightly* to *Very disruptive*). While Table 1 reports the average impact of the disruption for all organisations, Table 2 reports the number of people that had any degree of impact from the infrastructure disruption. The infrastructure issues causing the highest number of respondents to experience some disruption were: Phone networks (141), Road Networks (134), Electricity (118), Data Networks (116), and Water (114). Fewer than 30 organisations were impacted by Airport, Port, Gas and/or Rail network outages. It is important to remember that this number does not account for the quality or level of disruption. To understand that, we have also included the

mean weighted (by level of impact) score, for only those organisations that indicated being affected by disruption to services.

With respect to interruptions to Sewage systems, though only affecting around half (54%) of organisations, the mean reported level of impact was the highest at 0.75. While sewage was only an issue for just over half of our organisations, its impact on those organisations was severe. A similar level of impact (0.73) was reported in relation to effects arising from interrupted Road networks, however, this outage affected a larger proportion of organisations and businesses – 73%. Interestingly, though the interruption to gas affected only a very small proportion of organisations (9%), its mean impact score of 0.66 reached the threshold of ‘moderate disruption’. Conversely, interrupted Fuel supplies had a much wider impact to a larger proportion of organisations (36%), though in qualitative terms its impact was substantially less (0.54). Reflecting on the number experiencing an impact, and the severity of that impact is relevant for service restoration prioritisation.

Table 2: Distribution and average (mean) impact scores of level of disruption, by those organisations that indicated they were actively impacted by infrastructure service outages.

Impact to organisation from disruptions to:	Mean impact	experiencing disruption N	experiencing disruption %	Total responses
Sewage	0.75	95	54%	176
Road Networks	0.73	134	73%	183
Water	0.72	114	63%	182
Electricity	0.70	118	66%	180
Gas	0.66	15	9%	162
Phone networks	0.63	141	79%	179
Port	0.62	22	13%	165
Rail Networks	0.59	13	8%	166
Data Networks	0.58	116	69%	168
Fuel	0.54	60	36%	167
Airport	0.53	27	16%	166

### **Non-Infrastructure**

An average weighted disruption score was calculated based on the level of disruption experienced from the outage of various non-infrastructure issues. Weightings used were 0 for *not disrupted*, .33 for *slightly*, .66 for *moderately* and 1.0 for *very disrupted*. As noted above, the weighted averages include all respondents who responded by actively evaluating level of ‘disruptiveness’ to their organisation, rather than indicating they had no *loss of service or not applicable* (refer Approach section below). Data in Table 3 are sorted by mean weighted disruption score from highest to lowest and reflects a ranked list of non-infrastructure impacts affecting respondents from the business

community in the Canterbury district. Numbers of organisations who experienced the disruption are also included in the table.

The non-infrastructure issues with the highest weighted average disruption score, were Customer issues, Damage to local neighbourhood, and change in Emotional wellbeing. The least disruptive issue presenting with the lowest weighted average score was Machinery loss or damage.

Table 3: Average (mean) weighted disruption scores for outages of non-infrastructure issues (all respondents).

<b>Impact to organisation from disruptions to:</b>	<b>Mean weighted disruption</b>	<b>Number experiencing disruption</b>
Customer Issues	0.57	136
Damage to local neighbourhood	0.54	120
Changes in Emotional wellbeing	0.53	141
Difficulty accessing premises	0.53	103
Structural Damage to building	0.52	119
Non-structural damage to building	0.46	118
Damage to Inventory or Stock	0.45	98
Perceptions of building safety	0.44	115
Difficulty accessing IT data	0.40	94
Damage to next door	0.39	75
Damage to ground surface	0.38	81
Health & Safety Issues	0.38	88
Supplier Issues	0.37	96
Damage or loss of office equipment	0.35	85
Availability of staff	0.34	88
Machinery loss or damage	0.33	69

The proportions of organisations **that reported experiencing some level of disruption** (i.e. *Slightly to Very disruptive*) and their respective mean impact scores are shown in Table 4. The disruptions impacting the greatest number of respondents were: Changes in staff emotional wellbeing (141), Customer issues (136), Damage to local neighbourhood (120), Structural damage to building (119), Non-structural damage to building (118), Perceptions of building safety (115) and Difficulty accessing premises (103). The smallest proportion of respondents reporting non-infrastructure disruptions were the 69 organisations (36%) who indicated Machinery loss or damage.

Table 4: Distribution and weighted impact scores of level of disruption, by those organisations that indicated they were actively impacted by non-infrastructure service outages.

Impact to organisation from disruptions to:	experiencing disruption N	experiencing disruption %	Mean impact	Total responses
Changes in Emotional wellbeing	141	74%	0.64	190
Customer Issues	136	72%	0.69	188
Damage to local neighbourhood	120	62%	0.74	193
Structural Damage to building	119	61%	0.76	194
Non-structural damage to building	118	62%	0.63	190
Perceptions of building safety	115	60%	0.61	192
Difficulty accessing premises	103	55%	0.78	188
Damage to Inventory or Stock	98	52%	0.67	188
Supplier Issues	96	51%	0.56	190
Difficulty accessing IT data	94	56%	0.61	169
Health & Safety Issues	88	46%	0.6	191
Availability of staff	88	46%	0.55	190
Damage or loss of office equipment	85	44%	0.57	192
Damage to ground surface	81	43%	0.66	190
Damage to next door	75	39%	0.74	191
Machinery loss or damage	69	36%	0.61	194

Weighted mean disruption scores for the subset of organisations that reported being affected by non-infrastructure disruptions, produce a slightly different rank order of issues than those reported in Table 3, where all organisations have been included. The first four items in Table 4, all relate to accessibility to one’s own buildings or structural damage to own or neighbouring buildings. Although they did not present as the most prevalent issues, affecting between 39%-62% of organisations, these four items each had very high mean weighted mean disruption scores of .74 or above. Conversely, Staff availability effected had a narrower impact effecting less than half of all organisations, and the average impact at .55 was substantially less.

### How can you combine disruptions for further analysis?

This is addressed in the next Results Bulletin: 2018-6, Combining Disruptions Factors.

[www.resorgs.org.nz/Business Recovery Canterbury Earthquakes Combining disruption factors.pdf](http://www.resorgs.org.nz/Business_Recovery_Canterbury_Earthquakes_Combining_disruption_factors.pdf).

## Approach:

Measurement for disruption to non-infrastructure items was undertaken using the following question.

*For each of the following factors, please indicate whether they affected your organisation and, if relevant, how disruptive the impacts were.*

	Affected my organisation?		Not at all disruptive	Not very disruptive	Moderately disruptive	Very disruptive
	Yes	No				
Difficulty accessing IT data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Structural damage to building(s) (integrity of building compromised)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Non-structural damage (fittings damaged e.g. windows or light fixtures)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Machinery loss or damage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Office equipment loss or damage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Damage to inventory or stock	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Damage to ground surface	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Damage to or closure of adjacent (next door) organisations or buildings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Damage to local neighbourhood (e.g. other buildings in area, damage to pavements etc.),	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty accessing premises/site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health and safety issues for employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Supplier issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Customer issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Availability of Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perceptions of building safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changes in staff emotional wellbeing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please describe) -	_____					

Measurement of disruption to infrastructure items was undertaken using the follow question.  
*Following the earthquakes, how disruptive was the loss of the following infrastructure services for your organisation?*

	No loss of service or not applicable	Not disruptive	Slightly disruptive	Moderately disruptive	Very disruptive
Water Supply	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sewage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electricity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Phone networks (cell and landline)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data networks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Road networks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Airport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Port	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fuel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

For each of the infrastructure and non-infrastructure items, we recoded data where impact ranged from 0-1; *Not disrupted* = 0, *Slightly* = .33, *Moderately*= .66 and *Very* =1. Weighted averages were then calculated by generating a mean value for each infrastructure and non-infrastructure score.

### Limitations

This analysis assumes a similar level of perception of what *Very disrupted* means relative to *Moderately* or *Slightly*. Given the five-year time frame, it also assumes accurate recollection of impacts.

For further details on survey methodology, representativeness and limitations refer to Hatton, T., Brown, C., Seville, E., (2016) Business Resilience and Recovery following the Canterbury Earthquakes. *Survey 5 Results Bulletin 2016-01: Survey methodology*, Resilient Organisations, [www.resorgs.org.nz](http://www.resorgs.org.nz)

### References

Giovinazzi, S., Brown, C., Seville, E., Stevenson, J. R., Hatton, T., & Vargo, J. J. (2016). Criticality of infrastructures for organisations. *International Journal of Critical Infrastructures*, 12(4), 331-363.

### Reference as:

Hatton, T., Sampson, K., Brown, C., Seville, E., (2018) Business Resilience and Recovery following the Canterbury Earthquakes. *Survey 5 Results Bulletin 2018-5: Disruption Factors*, Resilient Organisations, [www.resorgs.org.nz](http://www.resorgs.org.nz)