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REVIEWING INDICES OF RESILIENCE AND ADAPTABILITY

DISCUSSION PAPER

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REGIONAL AUSTRALIA INSTITUTE

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EXECUTIVE SUMMARY

The overarching concept of resilience has gained much attention following the increase in natural hazards and shocks communities around the world are experiencing. It has been applied at different scales, from local community level to a national scale level, and to varying complexities.

Most assessments of resilience or adaptive capacity are based on the 'community capitals' framework developed in the 2000s. The community capitals framework sought to integrate social assets into approaches that had previously been defined around economic assets (such as land, labour and financial capital). In the community capitals framework, communities are understood to have a variety of assets of different types, known collectively as capitals.

There is a wide range of models and methods put forward to calculate resilience but there are four reasons why it is difficult to create a single metric to measure resilience:

1. Combining a wide range of factors into a single measure will inevitably mask the unique characteristics of some regions;
2. There is no agreement or how to best combine the factors into a single metric and the methods used vary and reflect individual researcher's judgement;
3. If the method to calculate the measure is too complex, it cannot be used easily and widely; and
4. Obtaining the data is challenging and as the measures that can be used in a resilience index are limited, proxy variables are used which weaken the analysis.

This discussion paper reviews the origins, design and purposes of 10 Australian resilience indices. The review finds that what is included in each index tends to pre-determine the outcomes – especially the rankings from high to low resilience. We also conclude that what's included in an index is heavily mediated by what's available, and while many indices seek to weave in social capital attributes, the absence of broadly available data on these attributes is an impediment.

We also found that only two of the indices demonstrate any attempts at validation – i.e., back casting the data to cover a period of natural disaster or economic transition and looking at how communities responded to validate the rankings inherent in each index

Our review found that most of the resilience indexes have applicability in the Australian context as there has been a range developed to target different levels from the national view to at a neighbourhood scale. They have tried to incorporate a wide range of factors that are associated with resilience within the limits of data availability.

Being able to measure resilience can help communities and governments determine risk and plan for disaster recovery. However, determinants of resilience may also differ between communities and given there is no best method of combining these factors into a single metric, it highlights the importance of cautious interpretation of the results when calculating resilience.

Nonetheless, such resilience indexes are still applicable for policymakers as they can provide a snapshot of resilience for the community, region, or state level. The "right" index needs to be identified such that all the information and data needed is available at that scale.

INTRODUCTION

There are several definitions for resilience that have been described in the literature and adapted by local communities and governments. The concept of resilience is applied to a range of disciplines including in relation to disaster and in terms of economic resilience to shocks. The overarching concept of resilience has gained much attention following the increase in natural hazards and shocks communities around the world are experiencing. It has been applied at different scales, from local community level to a national scale level, and to varying complexities[i].

Most assessments of resilience or adaptive capacity are based on the 'community capitals' framework developed in the 2000s and popularised for regional development by Cornelia and Jan Flora[ii]. The community capitals framework sought to integrate social assets into approaches that had previously been defined around economic assets (such as land, labour and financial capital). In the community capitals framework, communities are understood to have a variety of assets of different types, known collectively as capitals. The original framework has seven capitals:

1. Natural capital
2. Cultural capital
3. Human capital
4. Social capital
5. Political capital
6. Financial capital
7. Built capital

Most resilience and adaptive capacity measures use a variety of data sources to measure these seven capitals. However, there is little consensus about how resilience can be measured[iii]. There is a wide range of models and methods put forward to calculate resilience but generally it is difficult to create a single metric to measure resilience[xiv].

Firstly, combining a wide range of factors into a single measure will inevitably mask the unique characteristics of some regions[xiv]. Moreover, the metric would be highly sensitive to the factors that have been included[xiv].

Secondly, there is no agreement or how to best combine the factors into a single metric and the methods used vary and reflect individual researcher's judgement[xiv].

Thirdly, if the method to calculate the measure is too complex, it cannot be used easily and widely by everyone[iii].

Lastly, obtaining the data needed to be included in the measure is highly challenging as there is often a lack of consistent data across different jurisdictions and geographic scales[xiv]. As such, the measures that can be used in a resilience index are limited, and so often proxy variables are used.

STOCKTAKE OF RESILIENCE INDEXES

The following section summarises some of the different resilience indexes developed in Australia. This is by no means an exhaustive list of all resilience indexes but aims to show both the characteristics of some commonly used indices of resilience and adaptability as well as the diversity. It provides an overview of the use of each index, the principles it is based on as well as the measures/indicators that are included and in turn the strengths and weaknesses, and suitable application in an Australian disaster recovery context. Additionally, rather than providing a list of all indicators used for each index, we focus on highlighting some of the more challenging indicators in terms of measurement to demonstrate the approach taken to overcome such difficulties.

AUSTRALIAN DISASTER RESILIENCE INDEX[iv,v,vi,vii,viii,ix]

The Australian Disaster Resilience Index (ADRI) provides an assessment of disaster resilience at the national scale. It is the first national snapshot of the capacity for community resilience to natural hazards. It is produced by researchers from the Bushfire and Natural Hazards CRC and emergency service agencies, and built on research by the University of New England, to offer a nationally standardized index of resilience. The index helps to identify current resilience which can be a support tool for planning, development, policy, engagement and risk assessment by policy makers.

The index is presented as an interactive dashboard that allows uses to explore the resilience of their community as it provides information about the strengths and barriers to disaster resilience for each area in relation to state and national medians using maps and charts. The name of the index was changed to the Australian Disaster Resilience Index with the release of the dashboard. Note that previous research documents still retain the name of the Australian National Disaster Resilience Index.

The index is based on two capacities: ***coping and adaptive capacities*** and uses a top down approach. Under the two capacities, there are 8 key resilience themes which are measured by a range of indicators to create a composite index.

Coping capacity is defined as the means by which people or organizations use available resources, skills and opportunities to face adverse consequences that could lead to a disaster. It includes the following themes and indicator dimensions:

COPING CAPACITY INDICATOR DIMENSIONS

Theme	Indicator Dimension / Indicators	Data Source
Social Character	Social characteristics like immigration, internal migration, language proficiency, need for assistance, family composition, sex, age, education, employment and occupation	Australian Bureau of Statistics (ABS) 2011 Census
Economic Capital	Economic factors that influence ability to prepare for and recover like home and car ownership, income, employment and economy (diversity and population growth or decline)	ABS 2011 Census
Planning and the Built Environment	Dwelling type, Building codes, Disaster management planning, land use planning, local government financial status	ABS 2011 Census Geoscience Nexis Analysis of disaster management plans, planning schemes, Dept of

		Infrastructure and Regional Development
Emergency Services	Size of health response and emergence response workforce, emergency response capability, remoteness	Australian Institute of Health and Welfare, ABS 2011 Census, Productivity Commission Report on Government Services, RAI
Community Capital	Features of a community that facilitate cohesion and connectedness of community such as household support, access to services, wellbeing, unemployment, volunteering, place attachment and crime and safety	Social Health Atlas, ABS 2011 Census, State crime data
Information Access	- Community engagement and hazard education measured using emergency service agency expenditure on community engagement and engagement strategy. - Telecommunications	Annual reports and budgets, Department of Communications

Adaptive capacity looks at the processes that enable adjustment through learning, adaptation and transformation.

ADAPTIVE CAPACITY INDICATOR DIMENSIONS

Theme	Indicator Dimension / Indicators	Data Source
Governance, Policy and Leadership	Capacity within government agencies to learn, adapt and transform measured by looking at the capacity for institutional learning and innovation, leadership style, resource levels. Age of legislation and/or policy as well as update of resilience strategic directions. Expenditure on R&D and presence of research organizations	Annual reports, policy documents, organization plans and budgets, RAI InSight
Social and Community Engagement	Capacity within communities to learn, adapt and transform looking at ***skills for learning*** like participating in continuing adult education and population with university level education. ***Social engagement*** measured by change in net migration rate, life satisfaction, generalized trust, having a say and local governance, equity and inclusion, informal social connectedness, community involvement, sense of belonging, community economic wellbeing and community leadership and collaboration	ABS 2011 Census, ABS data, NATSEM, Regional Wellbeing Survey

These measures used are consistent with the community capitals framework and have much in common with measures used in assessments of disaster resilience internationally. The measures in this index have been extended to include elements of emergency management in Australia. The index also includes adaptive capacities related to learning, adaptation, and transformation.

The data collection was completed in 2017 and the following table shows the 88 indicators used across the 8 themes, at the SA2[1] level of geography. The selection of indicators to use were based on the availability of data covering the whole of Australia, the measurability and interpretability of the indicator, as well as the relationship between the indicator and natural hazard resilience. There is a mixture of quantitative and semi-quantitative indicators. Statistical methods were used to produce the index, which ranges from 0 to 1 (low to high capacity for disaster resilience).

Theme	No. of indicators	Indicators
Social Character	15	• % of population arrived in 2001 onwards • % households with all or some residents not present a year ago • % speaks English not well or not at all • % population with a core activity need for assistance • % one parent families • % households with children • % lone person households • % group households • Sex ratio • % population aged over 75 and % below 15 • Ratio of cert/postgrad to year 8-12 education attainment • % labour force unemployed • % not in labour force • % employed as managers and professionals
Economic Capital	15	• % residents owning their home outright, % owning their home with a mortgage and % renting • Median weekly rent, monthly mortgage repayment, weekly personal income and weekly family income • % families with less than $600 per week income and % with more than $3,000 • % employment in largest single sector • Economic Diversity Index • % businesses employing ≥ 20 people • Retail and/or commercial establishments per 1,000 people • % population change 2001 to 2011 • Local government grant per capita
Emergency Services	13	• Number of medical practitioners, registered nurses, psychologists, welfare support workers, available hospital beds, ambulance officers and paramedics, fire and emergency services workers, police, fire service volunteers and SES volunteers per 1,000 population • Fire and emergency services and SES organisations funding, and ambulance organisations funding per 1,000 population • Distance to medical facility (km)
Planning and built environment	10	• % caravan and improvised dwellings • % residential dwellings built post 1981, and % commercial and industrial dwellings built post 1981

[1] Statistical Area 2 (SA2) is a medium-sized ABS geography which typically covers 3,000-25,000 people and on average covers about 10,000 people. There are 2,310 SA2 regions across Australia. The SA2 geography aims to represent a community that interacts together socially and economically, and is the smallest scale at which most ABS statistics are released.

		• Emergency planning assessment score • FTE council staff • Council area per FTE council staff • Number of dwellings per FTE council staff • New dwellings (2012-2016) as a proportion of 2011 dwellings • New dwellings per week (2015-2016) • Planning assessment score
Community capital	11	• Offences against person/property per 100,000 population • Age standardised number of people per 100 population who feel safe walking in their neighbourhood / are able to get support in times of crisis / whose household could raise $2,000 in a week / had difficulty accessing services / with fair or poor self-assessed health • % households with no motor vehicle • % residents in same residence for greater than 5 years • % population undertaking voluntary work • % jobless families
Information access	3	• % area with excellent or good ADSL coverage • % area with mobile phone coverage • Community engagement score
Social and community engagement	6	• % population with life satisfaction scale 70 and above • % population with high generalised trust • Migration effectiveness 2006-2011 • % population with post school educational qualification • % population over 15 in further education • % participation in personal interest learning
Governance and leadership	4	• Presence of research organisations • Business Dynamo Index • Local economic development support • Emergency services governance, policy and leadership score[2]

The index also identifies 5 disaster resilience profiles in Australia according to strengths and barriers to disaster resilience. Each profile group identifies SA2s with similar patterns of resilience. The profiles provide the opportunity to address specific constraints and strengths of an area. By being able to identify other similar areas, regions can look at what those areas have done to improve resilience and assess if it works for their own community as well as allow opportunities for dialogue with other resilience partners.

This index can be considered as comprehensive, given the number of indicators that have been included. It would be useful in providing a measure of resilience at a national scale and is also good for local areas as it provides a measure at the SA2 level. Governments can use it in planning for action to increase disaster resilience. However, given the large amount of data that goes into the index and the mix of sources drawn on it is likely that not all the data included will be updated regularly so the currency of the indicator will vary over time. For instance, there is a large proportion of data that is sourced from ABS census which is only updated every five years. As such, the report does suggest that the index has a currency of 7-10 years because of the national scale of the assessment.

[2] Four indicators were derived from content analysis of policy, legislation and other documents. The procedures for deriving these indicators are described in Parsons, M., Reeve, I., McGregor, J., Morley, P., Marshall, G., Stayner, R., McNeill, J., Glavac, S. and Hastings, P. 2019b. The Australian Natural Disaster Resilience Index. Volume II – Index Design and Computation. Bushfire and Natural Hazards CRC, Melbourne. 830 pp. Available from https://www.bnhcrc.com.au/publications/biblio/bnh-7100

Additionally, particularly difficult to measure and update are the more qualitative measures relating to the very important dimensions of governance, policy & leadership, and social & community engagement. There are few widely available data sources for these important measures which means that proxies have to be used and these are often poor substitutes for the measures needed. This issue is discussed further below in the section on the Productivity Commission's Economic Metric of Relative Adaptive Capacity Index.

NEIGHBOURHOOD DISASTER RESILIENCE INDEX (NDRI)[x]

Neighbourhood disaster resilience is defined as "the capacity of community and its built environment at neighbourhood scale to absorb the impacts of disaster and recover in a timely manner after disaster to reach and maintain an acceptable level of functioning and structure while learning from past incidents".

Researchers from Griffith University and University of Queensland created the NDRI index and validated it using the Brisbane and Ipswich floods. The resilience scores and recovery outcomes were mapped, and regression analyses were conducted to examine how the selected resilience variables contributed to recovery outcome.

The NDRI looks at resilience attributes (robustness, redundancy, resourcefulness, and rapidity) within each resilience sub-component (social, economic, physical, and environmental) that contribute to quick recovery after disaster or absorbing the disaster impact. Around 93 indicators were selected and eventually 51 indicators were tested. The decision on what indicators to include was guided by the criteria: a) justified in the literature; b) consistent quality data available; c) data scalable or available at different scales. The selected indicators were aggregated to calculate a single score for each sub-component which were summed up to get the overall composite score of neighbourhood disaster resilience. Most of the indicators are available through ABS Census data, while some of them are State or local council-based data.

Resilience Sub-Components:	**Variables**	**Some examples of indicators used (not limited to those listed)**
Neighbourhood Social Resiliency Index (NSoRI)	Not Vulnerable Population	% population not need assistance % renter renting public housings % no single parent family – family composition
	Place Attachment	
	Access to Resources	% education > year 8 % population with sufficient English
	Participation	
	Human Capital	SEIFA
Neighbourhood Economic Resiliency Index (NEcRI)	Sensitivity/Vulnerability	%Commercial buildings constructed after 1981
	Economic and Livelihood Stability	% employed Median family income % female labour force participation
	Resources Equity	Financial and insurance services per 10,000 Healthcare and social assistance services per 10,000 SEIFA
	Diversity	% not employed in primary industries Retail centres per 10,000
Neighbourhood Physical Resiliency Index (NPhRI)	Physical Exposure	
	Medical Capacity	
	Temporary Sheltering Capacity	No. of schools, % of recreational land, no. of sports facilities and place of worship per 10,000
	Emergency Response Capacity	

	Communication Capacity	
	Transportation Capacity	% units with motor vehicle access % occupied housing units with a vehicle available Intersection density per 10,000 Principal road
Neighbourhood Environmental Resiliency Index (NEnRI)	Risk and Exposure	
	Protection Resources	% wetland, swap, marsh or natural barrier % developed open space % of land that does not contain impervious surfaces
	Disaster Frequency	

This index does not include an institutional component as it looks at a neighbourhood scale, which would be different from a local government area scale. However, the overall results showed that the proposed components and most of the subcomponents were statistically significant with recovery after flood, though more research needs to be done to check the sensitivity and uncertainty in variable selection and aggregation methods for calculating the composite indicators.

As reported in the study, the NDRI scores can help to show which neighbourhoods were high or low in disaster resilience and show where distinct spatial clusters exist. The scores of each resilience sub-component also helps to highlight the underlying factors to the patterns seen in NDRI scores. Therefore, the NDRI could be useful in the planning process as it allows local government to assess resilience of neighbourhoods and increase preparedness according to which sub-component a place is underperforming in. The ability to determine resilience at a neighbourhood level has much applicability for disaster recovery as more targeting actions can be developed.

AUSTRALIAN REGIONAL CAPACITY INDEX (ARCI)[xi,xii]

Developed by KPMG, the Australian Regional Capacity Index shows the relative regional resilience of each region and in turn the capacity for adaption and adaptability. It seeks to quantifiably assess if a place can achieve growth post-shock. The ARCI draws on the same methodology and techniques used in the US Regional Capacity Index that was developed by the Institute of Government Studies at University of California, Berkeley. It is a single index that summarizes a region's ability to bounce back using 12 equally weighted indicators that are classified under 1 of the 3 capacity types:

Capacity Types	ARCI indicators	Measures
Regional Economic capacity	Income equality	Gini Coefficient
	Economic diversification	
	Regional affordability	% of households spending up to 30% of gross income on housing
	Economic dynamics index	Includes 4 factors – R&D spend per $10,000 GDP (25%), annual establishment churn (25%), proportion of households with internet access (25%), average large and small establishments (12.5% each)
Socio-demographic	Educational attainment	
	Female labour force participation	
	Out of Poverty	Poverty threshold including housing costs calculated by the Melbourne Institute of Applied Economic and Social Research to estimate proportion of households in each jurisdiction who are 'out of poverty'
	Life expectancy	

Community Connectivity	Incarceration rates	
	Net overseas migration	
	Participation in sport	ABS survey
	Voter participation	Proportion of informal votes cast as an indicator of community engagement.

The index tried to use data available on a time series basis to allow for evaluation of the changes in resilience over time. Each indicator is calculated on a z-score basis, which shows how many standard deviations a region's performance deviates from the average. The RCI for a region is the average of its z-scores for each of the 12 indicators. The ARCI outcomes were also validated against gross state product over the same time period.

The index helps to identify which jurisdictions are resilient to shocks as well as which aspects (i.e., economic, or social and community) of places are less resilient. This allows for policy to target and address these areas to strengthen resilience. However, the results presented have been limited to the State level and much of the data used is not available at a smaller geographical scale.

VICTORIAN EMERGENCY MANAGEMENT COMMUNITY RESILIENCE INDEX[xiii]

The Victorian Emergency Management Community Resilience Index (VEMCRI), developed by Emergency Management Victoria (EMV), uses the components of the national-scale Australian Natural Disaster Resilience Index (ANDRI)[3]. However, due to differences in index scope, design, scale, audience, visualisation, user requirements and milestone delivery the ANDRI was not directly used.
It is targeted to provide baseline information on community resilience so that authorities can use it to inform recovery planning. It is presented as an online database of community resilience indicators and is 'live' to include updated indicator data over time.

ECONOMIC METRIC OF RELATIVE ADAPTIVE CAPACITY[xiv]

The Productivity Commission developed a single economic metric that can be used to identify regions most at risk of failing to adjust successfully to economic disruptions. An index of the relative adaptive capacity for each functional economic region was developed using data from the 2016 Census of Population and Housing, as well as other data sources. The analysis was conducted at the Statistical Area Level 2 (SA2) level.

The index of adaptive capacity does not classify whether regions would be successful in transitioning following a disruption. Instead, the realized outcomes are dependent on the sensitivity of a region to particular disruption, the predictability, type and magnitude of a shock (or shocks), the opportunities available in regional communities, and decisions made. As such, this does restrict the suitability of the use of the metric in policy decisions, but it can be used to explore the overarching patterns of adaptive capacity across regions and as a 'litmus test' to identify regions that might be at risk of not being able to transition when exposed to a fundamental shock.

It includes a range of factors that are considered to have influence on the capacity of a region to be resilient such as: people-related factors (educational achievement, employment rates, skill levels,

[3] Also known as the Australian Disaster Resilience Index (ANDRI).

personal incomes, and community cohesion); the degree of remoteness and accessibility to infrastructure and services; natural endowments (such as agricultural land) and industry diversity. The factors included in the metric have been identified as being important for adaptive capacity through literature and study participants. However, in many cases the data that would reflect the factors were unavailable. As some proxies had to be used to measure some of the factors, there were large ranges in scores for some regions.

The table below gives examples of indicators that were **NOT AVAILABLE** and the proxy measures used in the metric:

Type of factor	Ideal indicator	Available indicators (included in metric)
Human Capital	Average number of years spent in employment	Employment rate
Financial Capital	Net wealth of the community	• proportion of people earning high incomes • median property sale prices • proportion of people living in owner-occupied dwellings • proportion of people receiving a government pension or allowance
Physical Capital	Resale value of existing machinery	Value of non-residential building approvals per person
Natural Capital	Value of discovered and undiscovered minerals	• proportion of land used as national parks or nature reserves • proportion of people employed in mining
	Access to fresh water	None
	Liveability of a region	None
Social Capital	Leadership capacity of individuals	None
	Ability of a community to work together or achieve common goals	Proportion of people involved in volunteer work
	Willingness to contribute to the community	

The Commission's discussion of the development of the metric shows that it was concerned that it is often difficult to measure attributes thought to be associated with adaptive capacity, especially attributes that are more community or organisationally based. Examples are the leadership capacity of individuals, the willingness to work together to achieve common goals, and the general liveability of a region. Each of these has been highlighted in research literature as being important in building adaptive capacity, but it is difficult to find ways of measuring these attributes.

This led the Commission to look for proxy measures of these attributes, but as can be seen in the table above, the proxy measures are often poor substitutes for the original intention. The social capital attributes of ability to work together and willingness to work together are both included under the Census variable 'proportion of people involved in volunteer work'. While there is clearly a positive connection between the Census variable and these attributes, the variable is a poor proxy for the sense of community cohesion that the social capital attributes seek to reflect.

The Commission has set out a good example of the divergence between the 'ideal' indicator and the proxies when creating an index. Even So, 111 SA2 regions not included in the index of adaptive capacity because of the lack of relevant data needed for analysis.

This metric is useful in helping to determine if a region is able to "survive" a shock to their economy. However, its application is limited by the availability of data for the large number of factors that need to be included.

COMMUNITY ECONOMIC RESILIENCE[xv]

The authors focused on economic resilience, which is identified to be a topic that is under-researched, lacks clear definition and a well-defined framework for measurement. ***Community economic resilience (CER)*** is defined as "the capacity of the community as a whole to withstand shocks and enhance its economic activities after being adversely hit by shocks". Using a constructive (ex-ante) approach, which quantifies the potential CER using the following factors:

- Human Capital
- Financial Capital
- Natural Capital
- Physical or Built Capital
- Social Capital
- Diversity of Economic Structure
- Accessibility

This approach will allow communities to predict their resilience before it is evidenced and allows theoretical components of CER to be captured. It can help to meet the needs of various research disciplines and is useful for policy-making processes.

However, like the economic metric of adaptive capacity, the main disadvantage of measuring CER through its attributes is that it is heavily reliant on data as each factor would require several proxy variables that may not be available at the community scale (i.e., small statistical areas). For instance, natural capital data tends to be in an aggregated form so it would require data manipulation to re-estimated and disaggregated at a community level. Moreover, the index is highly sensitive to the proxy indictors selected for each factor.

MARKYT COMMUNITY RESILIENCE SCORECARD[xvi, xvii]

The MARKYT Community Resilience Scorecard was undertaken in response to COVID-19 by CATALYSE with support from LG Professionals WA and funded by the Department of Local Government, Sport and Cultural Industries (DLGSC) from the 5 June to 8 July 2020. The scorecard was open to all residents aged 18+ across Western Australia.

It involved an online/hard copy survey and received responses from 7666 community members across 128 local government areas. It looked to measure community wellbeing status, resilience rating, and find out what do communities need from local government and where should local government prioritize efforts to help with the response and recovery to COVID-19 impacts.

The survey responses were weighted by gender, age and location. As originally set out, the survey was able to gather responses across a wide breadth of issues relating to COVID-19 by providing insights on what people's concerns are relating to COVID-19, the level of community well-being which signals the level of resilience in response to the pandemic, local government performance in terms of responses and communications, and the main community needs for recovery. While most of the

indicators have used Census data, this community resilience scorecard is primary data that has been collected recently.

The data is likely to be used for informing local government responses in relation to COVID-19 recovery and future development as it highlights what areas are of concern to the community.

REGIONAL RESILIENCE MONITOR (RRM)[xviii]

Developed by Federation University for Regional Development Australia (Gippsland), the RRM consists of 6 indices which include the factors often presented in academic and grey literature that contribute to a local community's resilience. The RRM is an additive model of the 6 indices:

$$RRM = \omega 1\ EH + \omega 2\ HC + \omega 3\ SW + \omega 4\ LV + \omega 5\ ENT + \omega 6\ SC$$

Where: ωi are weights to be determined. Two options are proposed: a) uniform weights, and b) stakeholders informed best estimates.

- EH is the Economic Health Index
- HC is the Human Capital index
- SW is the Social Well-being Index
- LV is the Liveability index
- ENT is the Entrepreneurialism index
- SC is the Social Capital and Social Network index

The study highlighted the challenges that were present in using some of the Key Performance Indicators (KPIs) for the RRM. This included:

- the lack of availability of information at the local or town level,
- cost effectiveness of collecting the data,
- consistency over time,
- consistent methodology,
- being substantiated by current research,
- credibility of source,
- ease of interpretation,
- sufficient sample size, and
- relevance to stakeholder groups

The measures used to calculate the RRM are at the Local Government Authority (LGA) level and are from existing databases from the ABS, Universities Australia, and Victoria State level departments and agencies such as the Victoria Department of Health, Victoria Police, Victorian Commission for Gambling and Liquor Regulation,

Under the entrepreneurialism index, human capital was calculated using the Gippsland Economic Modelling Tool and entrepreneurialism attitudes and aspirations were collected using a regional entrepreneurialism survey. This survey is a regional version of the Global Entrepreneurship Monitor and was piloted as a telephone survey in Baw Baw, Latrobe City and Wellington Shire.

Additionally, under the social capital and social network index, some of the targeted dimensions (network relations, nature of relationships and network features) included data from a newly

developed tool based on Social Network Analysis. A business networking pilot study was carried out on 2 organisations within the Gippsland region to provide information on the type, extent, and reason for communication between businesses and other people outside the organisation.

List of the proxy measures used:

Indices of RRM	Targeted dimension	Proxy measure from existing databases
Economic Health	Income level	Personal income ($)
	Employment status	Employment participation rate (%)
	Housing values (stock)	Median house price, average rent and mortgage payments, building approvals
	Business conditions	Number of businesses
	Size of economic unit	Area of LGA
	Employment diversity	Industry of employment by occupation, share of non-dominant industry (%)
Human Capital	Education/Skills	% of population with higher edu qualification, share of population who did not complete year 12, FTE students
	Support to education	Students and apprentices receiving youth allowance
	Labour Force	Sum of estimated resident population (ERP) 15-64 years
	Population	Population density
	Health	Share of people reporting fair or poor health, type 2 diabetes, overweight or obese, and 1-share of low birth weight babies
	Children Development	1-share of children developmentally vulnerable in one or more domains
	Language Skills	1-share of low English proficiency
	Immigration	New settler arrivals per 100,000
	Refugees	1-share of humanitarian arrivals
	Relative socio-economic disadvantage	IRSD index
Social Well-being	Community Bonds	% of people who participated in citizen engagement in the past year
	Family Bonding	Child care/kindergarten sites, average aged care places per 1000 eligible population, 1-share of people 75+ and living alone
	Volunteer Work	% of people involved in voluntary work
	Density Medical, GPs	Dental services, GP and pharmacies per 1000 population, % of population with private health insurance
	Drugs/Alcohol attitudes	1/drug and alcohol clients per 1000 population, 1/density of intentional injuries treated in hospital per 1000 population
	Social assimilation	share of low English proficiency, people receiving support from Centrelink per ERP 15-64, new settler arrivals per 100,000 population, humanitarian arrivals as share of total arrivals
	Hospital admissions	1/hospital inpatient separations per 1000 population
	Criminal activity	1/crime against person, property per 100,000 people, 1/crime rate density per 100,000 people, % of people who feel safe on street after dark, 1/total criminal offences per 1000
	Relative socio-economic disadvantage	IRSD index
	Social Housing	Social housing as a share of dwellings
	Gambling attitudes	1/gaming machine losses per head of population, 1/gambling venue numbers
	Community openness	Community acceptance of diverse cultures, (%)
	Schools	Number of schools
Liveability	Road connectivity and geographical remoteness	1/ARIA index
	Internet access	% of households with internet connection
	Employment	Employment participation rate
	Employment diversity	Industry of employment by occupation, share of non-dominant industry
	Smoking preferences	% support smoking ban in outside seating areas, 1=share of makes 18+ who are current smokers
	Alcohol	Liquor licenses per 10,000 residents 15+, 1/alcohol-related hospital admission rate per 10,000

	Schools	No. of schools, TAFE, university, child care/Kindergarten sites
	Security	% of people who feel safe on street after dark
	Air quality	1-persons reporting asthma
	Resident perception	People who believe the area has good facilities and services, (%)
	Distance to work	1-people with at least 2 hr daily commute
	Distance to Health service	1/distance to nearest health service
	Work-Life Balance	% of people with an adequate work-life balance
	Affordability	1/median rent for a 3 bedroom house, % of rental housing that is affordable, 1/median house price
Entrepreneurialism	Climate	Extent of diversification in economy, Human capita, Infrastructure, Extent of 'red tape' e.g., length of time for building approvals
	Activities	New firm creation, Firm closure
	Attitudes	Networking and Attitude to failure
	Aspirations	Positive support for entrepreneurs in regional and national culture, Intention to start business, Skills and competence, Market opportunities
Social Capital and Social Networks	Community Bonds	People who participated in citizen engagement in the past year (%)
	Family Bonding	Child care/Kindergarten sites, Average aged care places per 1,000 eligible population, Share of people 75+ and living alone (%), People who share a meal with family at least 5 days per week (%)
	Volunteer work	% of people involved in voluntary work
	Social assimilation	People receiving support from Centrelink per ERP 15-64, new settler arrivals per 100,000 population, Humanitarian arrivals as a share of total arrivals (%)
	Criminal activity	% of people who feel safe on street after dark
	Community openness	Community acceptance of diverse cultures
	Network relations	→ Influence → Type of communication → Type of support
	Nature of relationships	→ Importance
	Network features	→ Frequency → Formal/informal → Size → Density → Centrality

ECONOMIC RESILIENCE INDICATORS FOR AUSTRALIA'S REGIONS[xix]

Presented at the 61st Annual Australian Agricultural and Resource Economics Society (AARES) Conference (2017), it presents what factors were included in identifying economic resilience of regions as the research aim was to develop an indicator. Overall, the index allows for the users to complete a health check on regional economies, and it is a concise composite indicator based on variety of factors.

Annual data for 29 regions in NSW was used. It covered 8 variables from 2010 to 2014. The data used was from ABS hierarchical regional data such as the National Regional Profile and labour force employment statistics.

• **Building Approvals** • **Estimated Resident Population** • **Net Regional Migration** • **Patent Applications** • **Trademark Applications**	REGIONAL CHARACTERISTICS

• **Employment Rate** • **Unemployment Rate** • **Participation Rate**	LABOUR CHARACTERISTICS

A cross-sectional regional index was derived (5-year average index) on how each region scored on the regional characteristics and labour market component. A regional resilience index was also created by looking at each individual NSW region and its interaction with time.

This index uses ABS data and therefore has a similar structure to many of the other indexes. Although in comparison to some of the other indexes it has limited variables, which may limit the comprehensiveness of the resilience, but as it does not rely on ABS census data which can only be updated every five years, it can be recalculated more frequently. Since it does not involve many variables and relies on datasets that is available nationally, it is more likely that the data would be available and can be replicated more easily for other states.

COMMUNITY AND HOUSEHOLD DISASTER RESILIENCE TOOLKIT[III]

The Torrens Resilience Institute (TRI) was concerned with designing a model to measure community disaster resilience and develop a pragmatic and simple tool for community stakeholders to use to measure disaster resilience in the community. As a result, they created a Scorecard that allows communities to measure their disaster resilience and to help stakeholders in determining priorities, funding allocation and effectively plan for disasters.

They also developed a second toolkit for household disaster resilience to be used by government, non-government, and community-based organisations. This was to help provide information on hazards and community and regional preparedness resources to help meet the needs of households to build resilience.

In developing the community toolkit, there were 5 stages which consisted of a grey and scientific literature review, defining community disaster resilience, creating a relevant model and tool, testing of the tool and model, and evaluating it in four trial sites.

Community disaster resilience was defined to have 4 components: community connectedness, risk and vulnerability, planning and procedures and available resources. Questions that helped to explore these components were drafted and ranked on a five-point Likert scale, indicating a level of contribution to potential resilience from extremely low to very high. Summing up the total points for questions in each section would generate a total Scorecard and allows the community to be ranked in the lowest quartile (red or danger zone), the middle two quartiles (caution zone) or the highest quartile (green or going well). Additionally, to be of a practical length and that the likelihood of information being available, it consists of only 22 questions.

However, the study found that collecting information for the tool was particularly challenging in relation to the availability of information available at the local government scale. Additionally, even if information was available, it was difficult to find. Nonetheless, the tool would be useful in helping communities and households create an assessment of their current resilience level and how they might be able to improve it pre-disaster. The short Scorecard and given that it was tested and refined based on feedback from communities is a strong positive and applicability of the toolkit.

REVIEW

Resilience and adaptive capacity indices in use in Australia are mostly designed around the Community Capitals Framework. Most seek to cover:

1. Natural capital
2. Cultural capital
3. Human capital
4. Social capital
5. Political capital
6. Financial capital
7. Built capital

Some consistent measures included are:

- Employment/unemployment rates
- Building approvals
- Population change/mobility
- Income distribution
- Single parent family share

Some of the variations are that:

- The Regional Resilience Monitor seeks to measure network strengths by developing a business networking pilot study based on Social Network Analysis.
- ADRI seek to include measures of the effectiveness of emergency services and measures of social engagement through broad based surveys such as the Regional Wellbeing Survey.
- ARCI seek to include incidence of poverty in the community.
- The RRM and the Economic Resilience Indicators for Australia's Regions aims to include measures of entrepreneurialism using measures such as through a survey to capture entrepreneurialism attitudes and aspirations as well as trademark and patent applications.

This review shows that what is included tends to pre-determine the outcomes – especially the rankings from high to low resilience. For instance, the Newcastle and Lake Macquarie region ranks high on the Economic Resilience Indicators for Australia's Regions, performing the strongest on regional characteristics in regional NSW (i.e., building approvals, ERP, net regional migration, patent and trademark applications) as well as relatively well on labour characteristics (employment, unemployment and participation rate). Under the Productivity Commission's (PC) Economic Metric of Relative Adaptive Capacity, Newcastle - Cooks Hill only falls under above average adaptive capacity[4]. It is likely due to the PC's relative adaptive capacity index including more factors that the region does not fare as well in. It also highlights how different indexes have used different geographical boundaries, which would also affect the resilience score. Additionally, under the ADRI, the Newcastle – Cooks Hill area falls under Group 3 in disaster resilience profile which is characterised by moderate strengths in social character, community capital, and social and community engagement. It scored low on other elements such as economic capital which was also measured in some form in both the PC's relative adaptive capacity index and the Economic Resilience Indicators for Australia's Regions, but the factors included were different.

[4] Above average regions are those above the mean index value and within one standard deviation of the mean (Productivity Commission Initial Report Pg. 161)

What's included in an index is however heavily mediated by what's available. The dilemma faced by the Productivity Commission in weaving social capital attributes into its index, in the absence of broadly available data on these attributes, was summarised earlier and was made clear by the Commission in its Report.

Most of the data readily available at small scale and uniformly across the nation tends to be Census or other government data. But the Census data can only be updated every 5 years and does not really capture social and institutional capital very well. For many indices this data is sought from surveys which add significant depth where response numbers and coverage are high – but they also bring a need for regular updating.

Few of the indices demonstrate any attempts at validation – i.e., back casting the data to cover a period of natural disaster or economic transition and looking at how communities responded to validate the rankings inherent in each index. Of the indices we have reviewed, only the NDRI seems to have tried validating its rankings and the Community and household disaster resilience toolkit trailed its scorecard at four sites.

Most of the resilience indexes have a strong applicability in the Australian context as there has been a range developed to target different levels from the national view to at a neighbourhood scale. They have tried to incorporate a wide range of factors that are associated with resilience within the limits of data availability. Being able to measure resilience can help communities and governments determine risk and plan for disaster recovery. However, determinants of resilience may also differ between communities and given there is no best method of combining these factors into a single metric, it highlights the importance of cautious interpretation of the results when calculating resilience. Nonetheless, such resilience indexes are still applicable for policymakers as they can provide a snapshot of resilience for the community, region, or state level. The "right" index needs to be identified such that all the information and data needed is available at that scale.

Summary of indexes

	Australian Disaster Resilience Index (ADRI)	Neighbourhood Disaster Resilience Index (NDRI)	Australian Regional Capacity Index (ARCI)	Victorian Emergency Management Community Resilience Index (VEMCRI)	Economic Metric of Relative Adaptive Capacity	Community Economic Resilience	MARKYT community resilience scorecard	Regional Resilience Monitor (RRM)	Economic Resilience Indicators for Australia's Regions	Community and household disaster resilience toolkit
Components of Index	Social character Economic capital Planning and built environment Emergency Services Community capital Information access Governance, policy and leadership Social and community engagement	Social resilience Economic resilience Physical resilience Environmental resilience	Regional economic capacity Socio-demographic Community connectivity	Similar to the ADRI	Human capital Financial capital Physical capital Natural capital Social capital	Human capital Financial capital Natural capital Physical/Built capital Social capital Diversity of economic structure Accessibility	Community wellbeing status Resilience rating What do communities need from local government Where should local government prioritize efforts to help with the response and recovery to COVID-19 impacts	Economic health Human capital Social well-being Liveability Entrepreneurialism Social capital and social network	Regional characteristics (building approvals, ERP, net regional migration, patent and trademark applications) Labour characteristics (employment, unemployment and participation rate)	Community connectedness Risk and vulnerability Planning and procedures Available resources
Strengths	Comprehensive with a wide range of indicators At the SA2 level	Able to show spatial clusters At the neighbourhood level Validated the index against disaster	Uses data available on a time series basis to evaluate change over time	Specific to Victoria State	At the SA2 level Comprehensive and involves a wide range of factors	Allow communities to predict resilience levels		At the LGA level Including methods of measuring difficult concepts such as social networks and entrepreneurialism through surveys Includes newly generated data	NSW focused Does not rely on ABS census data that is only updated once every 5 years Does not consist a wide range of variables which makes it easier to replicate and recalculate	Relies on community's evaluation of their own resilience Short scorecard takes into account practicality and information availability Toolkit was evaluated at 4 trial sites and refined based on community feedback
Weakness	Large amount of data Relies on ABS census	Does not include an institutional component	Limited to state level	Not much information about the index	Availability of data may be limited as it involves many factors Some proxy measures may be poor substitutes for original intension	Highly sensitive to proxy measures Some datasets would have to be disaggregated at the community level	Unclear how the data has been used so far	Entrepreneurialism and business networking survey were only on a pilot scale, may need to be carried out on a larger scale be validated Includes data from Victoria state government level that may not be available across other States, limited replicability	Limited factors are included	Availability of information available at the local government scale was limited May not be as comprehensive given the limited factors included

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