

Resilience within OECD Directorates: State of the Practice and Future Needs

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Introduction

The concept of resilience has been widely adopted by key stakeholders in government and the private sector to combat economic, social, and environmental risks across all levels of governance. The goal of furthering systemic resilience is aligned with Organisation for Economic Co-operation and Development (OECD) objectives to combat economic, social, and governance challenges presented by globalization through policy and best practice comparisons among member countries (OECD, 2008a; OECD, 2016h). Resilience became the core focus of OECD following the G20 St. Petersburg Leaders Declaration in 2013 to promote global economic resilience and has been defined as a top priority during the current G20 German Presidency (Carin, 2017; G20, 2014). Even though the OECD Public Governance Committee defined resilience as “the ability to resist, absorb, recover from or successfully adapt to adversity or a change in conditions” (which is consistent with the current consensus thinking in resilience science and practice), many OECD directives only touch on certain elements of resilience. Moreover, the emerging science of resilience has not been adequately featured in the body of work delivered by OECD. This paper comparatively reviews the discussion and communication of resilience concepts across OECD directorates and affiliate organizations, and subsequently identifies gaps and needs for improvement.

Science of Resilience

The concept of resilience has become prevalent among scientists, engineers, and planners in a range of disciplines in socio-ecological fields (e.g. ecology, urban planning, flood protection, drought management) and across public domains (e.g. city managers, state, regional, and federal officials). The application of resilience has been discussed within contexts such as disruption from climate change and the challenge of ecosystem management (MIT, 2015; United Nations, 2016; Walker et al., 2004). Further, resilience analysis and management can be considered as an extension of risk analysis and management for situations where there is incomplete information (i.e. emerging threats and/or complex integrated systems). Specifically, where risk operates on principles of mitigating potential loss, resilience is aimed at maintaining an acceptable level of performance within critical functions and preserving system service delivery within infrastructure, public health, daily commerce, etc. Where risk assessment uses established numerical thresholds to delineate acceptable and unacceptable losses, resilience integrates stakeholder and expert preferences to determine acceptable and unacceptable performance. Furthermore, whereas risk focuses on the state of a system preceding and at the point of a

disruptive event, resilience also considers system organization and performance at points during and in the aftermath of a disruptive event (Linkov & Palma-Oliveira, 2017).

The ability to measure resilience is required for its implementation in governance frameworks. Quantification methods have been developed to assess the phases of resilience, as defined by the National Academies of Science (Linkov, Trump, Fox-Lent, 2016; NRC, 2012). While quantification methods for resilience are less mature than for traditional risk assessment, resilience is applicable and helpful to deal with uncertain threats, which are either difficult or impossible to accurately quantify. Several quantitative, semi-quantitative, and qualitative approaches have been proposed and deployed to measure systemic resilience at local, national, and international levels for a variety of catastrophic events (generally those with low-probability, high-consequences). Some of these approaches could be relatively simplistic, for example with a qualitative classification system. Others are more complex, for example with resilience matrices or network analysis, where the availability of information and user preferences determines the level of sophistication deployed for a given resilience case (Linkov, Trump, Fox-Lent, 2016). In the case of the former, resilience matrices adopt a semi-quantitative approach to review the relative resiliency of critical functions of systems under stress. In the case of the latter, network analyses are used to quantitatively model how systems interact with one another, and ultimately model how the cascading impact of a shock to one system can trigger effects to various others.

When judging outcomes of hazardous events, resilience analysis fundamentally seeks to provide the groundwork for a ‘soft landing’, or the ability to reduce harms while helping the targeted system rebound to full functionality as quickly and efficiently as possible. This is consistent with the NAS definition of resilience, which has been applied by a number of US agencies not only for analysis but also as a common resilience definition (Linkov & Palma-Oliveira, 2017; Larkin et al., 2015; Linkov et al., 2014; EO-13636, 2013; PPD-21, 2013). According to the National Academy of Science (NAS), resilience is defined as “the ability to plan and prepare for, absorb, recover from, and adapt to adverse events”. The NAS definition highlights both anticipated and unanticipated risks (Linkov, Trump, Fox-Lent, 2016; NRC, 2012). Similar to the definition of resilience put forth by NAS, the US Executive Order on the preparation of the US for the impacts of climate change defines resilience as “... the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions” (Exec. Order No. 13653, 2013). This paper examines whether OECD directorates utilize standard approaches to the definition of resilience by searching for and evaluating select publications for inclusion of each of the NAS resilience features described below.

- *Plan/Prepare*: The steps taken by organizations to prepare critical functions and features of their operation for a universe of potential threats.
- *Absorb*: The capability of a system/organization to absorb the consequences of a shock without breaking and maintaining a certain degree of function.
- *Recover*: The time and resources needed for the system to recover its functionality post-shock.
- *Adapt*: The capacity of an organization or system to ‘learn’ and improve its capacity to absorb and recover from shocks based upon past experience.

Various OECD directorates and affiliated organizations use similar language that speaks to non-traditional means of risk assessment, risk monitoring, and capacity-building actions. In a similar

manner to NAS, the OECD Development Cooperation Directorate (DCD) defines resilience as the "...ability of households, communities and nations to absorb and recover from shocks, whilst positively adapting and transforming their structures and means for living in the face of long-term stresses, change and uncertainty" (OECD, 2016g). Other definitions of resilience put forth by OECD directorates are described in Table 2. While certain definitions of resilience put forth by the OECD such as by the Public Governance Committee are similar in manner to NAS, some OECD directorates only touch on certain elements of resilience within select publications (OECD, 2016i).

Comparative Review of OECD Resilience

The OECD is well-equipped to standardize resilience efforts across member countries because of its ability to create directives that are generalizable based on standard definitions and quantification mechanisms of resilience. Furthermore, economic networks are increasingly complex and shocks undergo cascading effects among systems without robust approaches to review the potentials for systems capacity-building and failure. This paper scores a select number of OECD directorate and affiliated organization materials for direct and indirect references to NAS phases of resilience, including planning, absorption, recovery, and adaptation (Table 1). Sample OECD documents were scored for direct definitions of resilience (large square, Table 1) based on direct use of the terms "plan," "absorb," "recover," and "adapt," or if synonym reference was made toward these terms. Indirect definitions of resilience (medium square, Table 1) were measured using metrics and/or indicators for each of these terms. The small squares in Table 1 denote a lack of both direct and indirect reference of resilience for each OECD publication.

The criteria used to determine direct and indirect classifications of resilience in the directorate materials were based on the following NAS terms and definitions: (1) "plan," occurs pre-event and comprises the preparation of the systems against the universe of identified threats; (2) "absorb," occurs during the event and increases the likelihood of system survival through the use of assets to mitigate system losses; (3) "recovery," occurs post-event during the implementation of resources to bring the system back to full function; and (4) "adaptation" promotes built-in system "learning" through the enablement of the system to change and better cope with system shocks. The justification for scoring of individual publications is laid out in Table 1. Various components of resilience are laid out in Table 2, including the definition of resilience provided within each publication, metrics used to describe resilience, and quantitative approaches to analyze resilience. Finally, resilience features relative to the NAS definition are mapped within the physical, information, and social domains of resilience, as shown in Figure 1. The criteria for the three domains were defined in the following ways: (1) "physical" focusing on investments in physical infrastructure, (2) "information" focusing on the flow of information and data moving up the system, and (3) "social" focusing on organization and planning of societal action and making society nimble in the face of shock.

Discussion

OECD directorates indicate that resilience is needed to combat economic, social, and environmental risks on social systems, including energy, climate, and finance. While OECD directorates were found to agree on the use of resilience within systems development, the definition of resilience differed within individual publications and, in some cases, resilience was not defined at all. Overall, directorates focused heavily on resilience planning and absorption with less emphasis placed on system recovery and adaptation. In a similar vein, directorates discussed resilience within the social domain more heavily compared to the domains of physical infrastructure and information (OECD, 2013). As a point of comparison, US agencies tend to discuss resilience within the physical infrastructure domain. OECD is, therefore, addressing a major gap in government-funded research in this area.

Within the physical infrastructure, information, and social domains, practitioners generally employ a variety of definitions, metrics, and tools to assess and manage resilience (Linkov, Trump, Fox-Lent, 2016; Lofquist, 2017). Components of resilience also differ among OECD directorates. The Development Co-operation Directorate (DCD), for example, explains that different tools are needed to measure risks to social and political assets compared to the impacts of geopolitical, economic, and natural hazards risks, which are relatively easy to assess (OECD, 2014b; OECD, 2016e). In the case of directorates such as the ED, IEA, and DPGTD, numerous quantitative approaches including risk, hazard, vulnerability, and needs assessments and economic and benefit cost analyses are utilized to determine and monitor risk impacts (OECD, 2016a, b, c, d; OECD/IEA, 2015; OECD, 2014a; OECD, 2011; OECD, 2013). Differences in these approaches can lead to different measures and outcomes and the ways in which resilience and risk management is prioritized.

An important consideration for any resilience work includes the interplay between promoting system resilience while foregoing potential status quo benefits such as economic opportunity. Economic policies, for instance, can present tradeoffs between growth and resilience. The Economics Department (ED1) refers to this as the growth-fragility nexus (OECD, 2016k). In this way, a policy, or a bundle of policies, can either be growth-enhancing or growth-limiting as well as either resilience-building or resilience-diminishing. Labor market flexibility can be increased (resilience-building) through reforms to employment protection legislation to have positive long-term effects (OECD, 2016j). However, when demand conditions are weak there can be significant negative impacts on private-sector employment (growth-limiting) within two-to-three years following such a reform. Tax policies designed to encourage investment and homeownership (growth-enhancing) can also be resilience-diminishing as firms and households assume excessive debt which can lead to financial risks and recessions in the face of an inadequate financial regulatory framework (OECD, 2016j). Therefore, resilience may not always promote aims like growth or cost-effectiveness. Instead, in such a case it is incumbent upon the Economics Department to guide structural policy reforms that both increase resilience and mitigate negative economic impacts. This requires a robust understanding of the relationships between different economic policies and financial climates in order to achieve a desired outcome. For instance, pairing product market reforms encouraging firm entry and job creation which provide a positive short-term impact can counter negative effects that reforms to employment protection legislation have in the near-term (OECD, 2016j). Once a firm and unified

conception of resilience is established, individual directorates can use this as a guide when recognizing and facing the unique tradeoffs and obstacles presented to them while building resilience in conjunction with carrying out their prescribed missions.

Overall, a normalized definition of resilience will enable OECD directorates to recommend more robust standards to OECD member countries. Specifically, certain OECD directorates are concerned with resilience building across the same systems of functionality (e.g., internet, fiscal, climate); in these instances, a normalized and streamlined definition of resilience across OECD directorates could be useful to compare the features of resiliency development across OECD subjects and resilience features. This is especially true in regard to the Economic Department (ED1) and Directorate for Employment, Labour, and Social Affairs (DESLA) where both directorates focus on methods that reduce the risk of severe recessions (OECD, 2016j, k; OECD, 2017). While ED1 is heavily focused on the exploration of policies that mitigate the risks and consequences of severe crises, DESLA focuses on system absorption and recovery to reduce long-term impacts once large economic downturns hit. Furthermore, DESLA assesses metrics such as job creation, employment incentives, unemployment, and training, whereas ED1 assesses metrics such as GDP growth rates, private bank credit, global real equity prices, real house prices, house price-to-rent ratio, and house price-to-disposable income ratio. Directorates within the OECD may wish to consider an effort to normalize and operationalize a definition of resilience within the OECD in order to streamline quantitative measurements pre-and post-shock events and to operationalize metrics that adequately measure resilience success. Normalization of resilience standards are vital given the increasing complexity of systems throughout member states and the cascading effects of shocks to interconnected, global systems (NATO Review, 2016).

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Table 1. Resilience Features in OECD Publications.

OECD Directorate	Document	Plan	Absorb	Recover	Adapt	Justification
International Transport Forum (ITF)	(Lofquist, 2017)	■	■	■	■	The resilience definition in this paper incorporates the words " <i>absorb</i> " and " <i>rebound</i> ." It alludes to the idea of recovery without a direct reference. It is focused on planning for the next impending event by making systems more adaptive to internal and external threats.
Environmental Directorate (ED)	ENV/EPOC/WPC ID(2016)3	■	■	■	■	This paper is dedicated to the planning stages of resiliency. It indirectly refers to absorb based on information provided in the Annex section. It did not include a real discussion on the adaptive capacity of the system.
Economics Department (ED1)	OECD (2016j)	■	■	■	■	This paper discusses the need for reducing vulnerability of economies to shocks and the need to strengthen the absorption capacities of systems to overcome and recover from system shocks. It puts forward structural policies which affect how the economy "adapts to secular megatrends".
	OECD (2016k)	■	■	■	■	Emphasis in this paper is placed on mitigating the risks and consequences of severe crises. The paper examines evidence from past economic disruptions as insight to enhance resilience moving forward suggesting adaptation.
International Energy Agency (IEA)	(OECD/IEA, 2015)	■	■	■	■	This paper indirectly refers to planning based on the discussion of international collaborations needed to handle future challenges. However, it did not include planning within their resiliency definition. The discussion of "emergency response capabilities" indirectly refers to absorb. Recovery and adaptation earn an indirect classification because of the lack of recommended actions related to its implementation.

OECD Directorate	Document	Plan	Absorb	Recover	Adapt	Justification
Development Cooperation Directorate-Development Assistance Committee (DCD-DAC)	DCD/DAC/RD(2016)18/RD1	■	■	■	■	This paper focuses on the development of a resilience systems analysis (RSA) framework as one part of risk and resilience planning. It recognizes and applies the RSA framework for use in resilience planning and has an indirect reference to adapt to climate change.
	OECD (2014b)	■	■	■	■	This paper focuses on the development of an RSA framework as one part of risk and resilience planning. It discusses how the framework assists with planning to identify the capacity-building measures to enhance absorption of impacts to the system.
Directorate for Science, Technology, and Innovation (DSTI)	OECD (2008b)	■	■	■	■	This paper directly references the development of an incident response capability during an attack (absorption) and development of a computer security incident response team (CSIRT) in charge of monitoring, warning, and alerting of an incident for preparedness.
	OECD (2015)	■	■	■	■	This paper provides guidance on national strategies for digital security risk management using preparedness social mechanisms to protect against threats.
Directorate for Employment, Labour, and Social Affairs (DELSA)	COM/ECO/CPE/WP1/DELSA/ELSA/WP5(2017)1	■	■	■	■	There is an indirect discussion of performance of "econometric analyses" associated with planning and adapted recommendations to help the system better cope with shocks. This paper focuses on system absorption and the recovery of labour markets to reduce long-term impacts from large economic downturns.
Directorate of Public Governance and Territorial Development (DPGTD)	OECD (2011)	■	■	■	■	This paper provides policy recommendations for urban resilience. Absorption is promoted through the use of eco-based adaptation projects in conjunction with hard infrastructure investment.

OECD Directorate	Document	Plan	Absorb	Recover	Adapt	Justification
	OECD (2014a)	■	■	■	■	This paper directly promotes OECD resiliency preparedness through use of foresight analysis, risk assessments, financing frameworks, and risk anticipation capacity. It indirectly references absorption by discussing the strengthening of emergency management capabilities.
	GOV/RDPC/URB (2016)4	■	■	■	■	This paper indirectly discusses preparedness by using surveillance mechanisms and risk assessment capabilities. It discusses the building of financial capacity, which is ultimately required to absorb shocks.
	GOV/PGC/HLRF(2016)10	■	■	■	■	Resilience planning is explained through the use of hazard maps. This paper references absorption through discussions related to actions like updating building codes in Switzerland.
	GOV/RDPC/RD(2015)2	■	■	■	■	Countries are assessed for the inclusion of resilience measures including planning, absorption, recovery, and adaptation. However, the paper content is only indirectly related because resiliency recommendations and paths forward are not provided.
	OECD (2016c)	■	■	■	■	This paper first focuses on adaptation by using lessons learned from past experiences to inform future planning, absorption, and recovery practices.
	GOV/PGC/HLRF(2016)9	■	■	■	■	Although it directly references all four phases of resiliency, the paper lacks a formal reference and definition of resilience in the document.
	OECD (2013)	■	■	■	■	This paper focuses on preparedness and absorption using decision analysis tools, as well as risk identification and crisis management measures. Recovery is mentioned as a feature of resilience but

OECD Directorate	Document	Plan	Absorb	Recover	Adapt	Justification
						<p>recovery methods are not heavily discussed. It focuses on previous implementation of OECD resilience measures in regards to adaptation for the future.</p>
	OECD (2014c)	■	■	■	■	<p>According to the paper risk prevention (preparation), includes both physical and social risks. It discusses structural and non-structural prevention techniques that help communities mitigate losses. Its definition of resilience includes recovery back to original function.</p>

Table 2. Components of resilience in OECD publications.

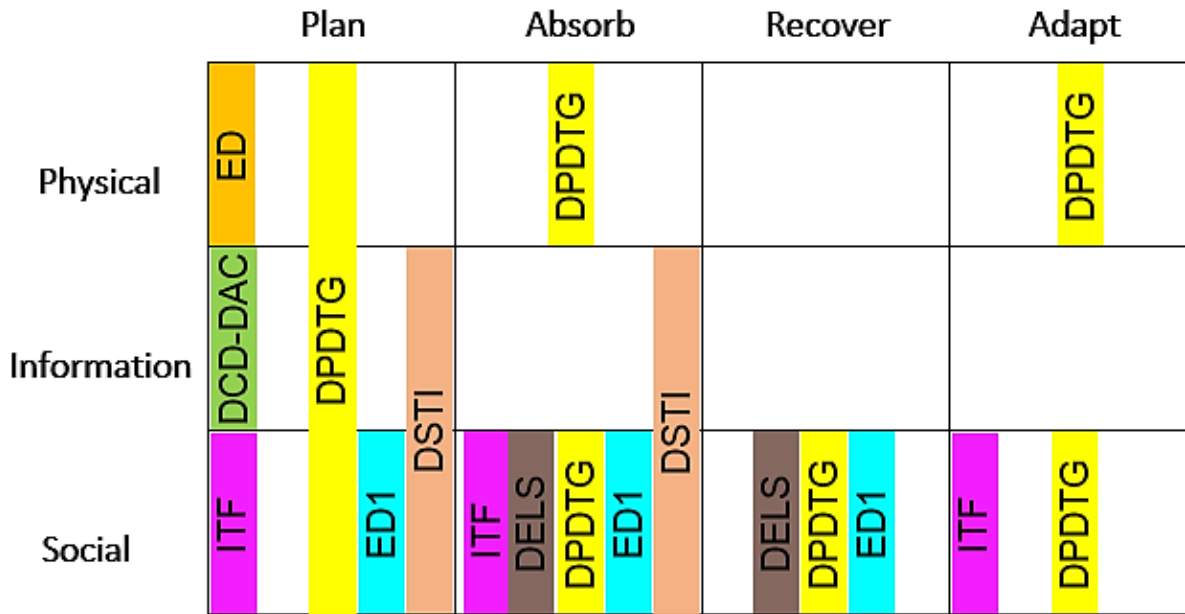
OECD Division	References	Resilience Definition	Resilience Metrics	Quantitative Approaches
ITF	(Lofquist, 2017)	<i>"System resilience is the ability for complex, dynamic-adaptive socio-technical systems to absorb and rebound from trauma or stress, and avoid "jousting with dragons" where results are uncertain, and often fatal."</i>	Incidents, Accidents	Maritime Safety Analysis
DSTI	OECD (2008b)	---	---	Risk Assessment
	OECD (2015)	---	---	Risk Assessment
ED	ENV/EPOC/WPCID (2016)3	---	Tonnes CO2 equivalent, Reduction in Water Levels (mm), Distance of Water Level Reduction (km)	Vulnerability Assessment Economic Analysis Cost Benefit Analysis Climate Risk Screening Tool
ED1	OECD (2016j)	---	GDP growth rates	---
	OECD (2016k)	<i>"...the capacity of an economy to reduce vulnerabilities, to resist to shocks and to recover quickly."</i>	Global Private Bank Credit (% of GDP), Global Real Equity Prices, Global Real House Prices, House Price-to-Disposable Income Ratio, VIX Volatility Index, House Price-to-Rent Ratio, Global Private Credit (% of GDP), Foreign Reserves to M2	Monitoring of Indicators – early warning vs. crisis occurrence (no formal analysis discussed)
IEA	(OECD/IEA, 2015)	<i>"Resilience of the energy sector refers to the capacity of the energy system or its components to cope with a hazardous event or trend, responding in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation."</i>	CO2, Physical and Financial Risks	Climate risk auditing Risk Assessments Vulnerability Assessments Climate forecasts

OECD Division	References	Resilience Definition	Resilience Metrics	Quantitative Approaches
DCD-DAC	DCD/DAC /RD (2016)18/R D1	---	Social Capital, Climate Change Adaption, Food Security, Economic Outcomes, Vulnerable Communities, Gender Equality, Human Rights, Democracy	Resilience systems analysis framework
	OECD (2014b)	<i>"Resilience means that states can better withstand environmental, political, economic and social shocks and stresses."</i>	Social Capital, Displaced Families, Democracy, Warning and Evacuation Systems, Control of Infectious Diseases, Crime, Unemployment, School Attendance, Mortality Rate	Resilience systems analysis framework
DELSA	COM/ECO /CPE/WP1/ DELSA/E LSA/WP5 (2017)1	<i>"[L]abour market resilience, i.e. an economy's capacity to limit fluctuations in employment and to quickly rebound in the wake of aggregate shocks."</i>	Direct Job Creation, Employment Incentives, Public Employment Services, Total Active/Passive Spending, Wages, Unemployment, GDP	Econometric analysis
DPGTD	OECD (2011)	---	Commodity Prices and Currencies, Public Debt, Budget Deficit, International Co-Operation, Cyber Crime, Epidemics, Pandemics, Population Density	Early Warning Systems Cost-Benefit Tests
	OECD (2014a)	<i>"...ability to resist, absorb, recover from or successfully adapt to adversity or a change in conditions..."</i>	Emergency Management Capabilities, Financial Protection Strategies, Vulnerable Populations, Critical Infrastructure Networks, Surveillance, Monitoring, and Alert Networks	Foresight Analysis Risk Assessments Public Finance Framework
	GOV/RDP C/URB (2016)4	<i>"...the ability of households, communities and nations to absorb and recover from shocks, whilst positively adapting and transforming their structures and means for living in the face of long-term stresses, change and uncertainty..."</i>	Vulnerable Populations, Private Assets, Critical Public Infrastructure, Insurance Coverage, Contingency Financial Planning, Development outside of Risk-Prone Areas, Eco-Based Adaptation Projects, Regional Insurance Schemes/Contingency Funds	Vulnerability and Risk Assessment Asset Inventory Hazard Assessment
	GOV/PGC/ HLRF (2016)10	---	Pandemics, Power Outages, Nuclear Accidents, Protective Infrastructure, Risk Awareness, Development in Risk-Prone Areas, Supply and Disposals, Transportation/ Energy Systems, Communications, Constructions/Installations/ Enterprises	Hazard Assessment

OECD Division	References	Resilience Definition	Resilience Metrics	Quantitative Approaches
	GOV/RDP C/RD (2015)2	<i>"Resilience is tentatively defined as the ability to absorb, recover (or bounce-back), adapt to the impact of economic, environmental and social shock or chronic pressure in order to promote sustainable development, well-being and inclusive growth."</i>	Local Property Tax, Disaster Prevention, Emergency Response, Disaster Recovery and Reconstruction, Infrastructure Resilience, Community Resilience	Compilation of National Policy Frameworks
	OECD (2014c)	<i>"...a system's capacity to absorb shocks and regain its ability to function."</i>	Hazard control, Vulnerability Reduction, Risk Awareness, Risk Culture, Water Height (Flood Zones), Critical Network Correlations, Road/Public Transport Networks, Drinking Water Production Systems, Electricity Network	Risk Assessment Economic Assessment Cost Benefit Analysis Multi-Criteria Analysis Geographic Information Systems
	OECD (2016c)	<i>"...the ability to absorb, adapt, transform and prepare for the past and future impacts of economic, environmental, social and institutional shocks and stresses."</i>	GDP, Employment, Patent Applications, R&D Expenditure, Population, Immigrants, Household Income, Poverty Level, GINI Coefficient, Perceived Safety, Crime Rate, Number of Community Associations, Public Services/Public Transport, Risk-based Land Use Strategy, Air, Water, and Green Space Quality/Quantity, Energy Consumption and Production, Smart Energy Management, City's Revenue by Sources, Number of Public Officials, Expenditure on Training, Open Government Data, Voting Rate	Risk Governance Framework Global Value Chain Modelling Foresight Analysis Risk Assessment Needs Assessment Financing Framework
	GOV/PGC/ HLRF (2016)9	---	Telecommunication Networks, Water and Electricity Supplies, Transportation and Financial Systems, Service Continuity of Critical Infrastructures	Stock Taking Report Analytical Framework/ National Case Studies

Figure 1. Resilience Features Addressed (relative to NAS definition) in physical, information, and social domains.

(a) OECD directorates



(b) US Agencies

