

1 Online Survey on Risk Communication

1.1 Get started: data and working experience

Table 1-1: Sectors where respondents are currently employed (Question: “To get started, we would like to know in which sector you are currently employed.”)

Answer	Number	Percentage
public sector (national level)	19	46,34%
public sector (regional level)	5	12,20%
public sector (local level)	8	19,51%
private sector	2	4,88%
university or research institute	3	7,32%
non-governmental organization (NGO)	2	4,88%
international development cooperation	1	2,44%
private person (consultant, etc.)	0	0,00%
others /no answer	1	2,44%

Table 1-2: Working area of respondents (Question: “In which area are you currently working?” More than 1 answer possible)

Answer	Number	Percentage
disaster risk management	19	46,34%
water and sanitation	7	17,07%
research and consultancy	4	9,76%
administration	3	7,32%
housing and construction	3	7,32%
energy supply and distribution	3	7,32%
planning	2	4,88%
transport	2	4,88%
education and training	2	4,88%
civil protection	1	2,44%
health	0	0,00%
telecommunication (telephone, radio, TV)	0	0,00%
other	7	17,07%

1.2 Risk communication in Peru

Risk communication involves the effective and accurate exchange of information and guidance about risks and hazards. The objective is to create risk awareness and understanding and to promote risk-minimising behaviours among individuals, communities and institutions. As in the current COVID-19 crisis or a sudden earthquake, risk communication begins at the latest when the event occurs. However, a comprehensive risk communication strategy already starts in the prevention phase, i.e. before an event occurs, and is a continuous process in all phases of disaster risk management: Prevention, Preparedness, Response and Recovery. Risk communication is thus the task of all actors involved in these phases, including the public sector, the private sector and the civil society. The involvement of all these actors in a risk communication process also promotes trust, credibility and acceptance.

In this part of the survey we are interested in your experience and personal assessment of risk communication in Peru.

Table 1-3: Overall assessment of risk communication (Question: “What is your overall assessment of risk communication between stakeholders in Peru?”)

Answer	within public authorities of the same government level	between the different government levels (national-regional-local)	between public authorities and the private sector	between public authorities and the academic sector	between public authorities and civil society organizations
very good	2	1	1	1	2
good	11	4	1	3	3
moderate	17	17	18	13	17
rather insufficient	4	9	13	10	8
insufficient	4	6	5	10	7
no answer	3	4	3	4	4

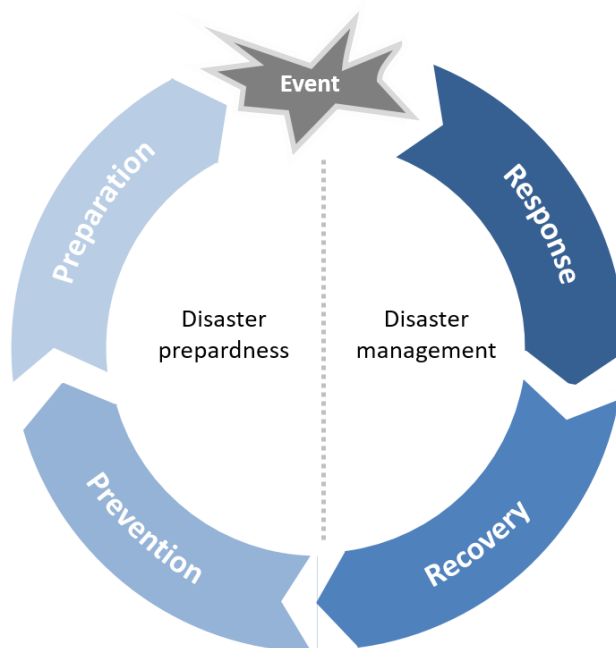


Figure 1-1: Phases of the disaster risk management cycle

Table 1-4: Challenges for risk communication (Question: “In your opinion, at which phase of the disaster risk management cycle do you see main challenges for risk communication in Peru?”)

Answer	in the prevention phase (preventing future emergencies or minimising their effects)	in the preparation phase (preparing to handle an emergency)	in the response phase (responding safely to an emergency)	in the recovery phase (recovering from an emergency)
no challenges	1	1	0	1
low challenges	1	1	3	3
medium challenges	4	9	12	7
high challenges	32	27	21	25
no answer	3	3	5	5

1.3 Multi-risk experience in Peru

Multi-risk events are defined as risks caused by hazardous events simultaneously, cascadingly or cumulatively over time, and taking into account the potential interrelated effects. For example, an earthquake can trigger a tsunami, or after heavy rainfall a landslide leads to the damming of a river. After the occurrence of a multi-risk event, there may arise impacts on critical infrastructure, such as the failure of water supply, power cuts, road blockages, destruction of bridges and associated shortage of supply for the population and/or economic sectors (e.g. transport, food supply, health services). In the case of complex interactions within a chain of risk events, we also use the term cascading effects.

Table 1-5: Multi-risk disaster experiences in Peru (Question: “If you have experienced a multi-risk disaster in the past or you have been professionally involved, we would like you to share your experience with us”)

ID	Where did it happen (city)?	Where did it happen (region)?	When did it happen?	What had happened?
52	Cajaruero	Amazonas	2019-10	Landslides, destruction of asphalt road, damming of streams, houses affected
44	Chimbote	Ancash	2017-03	Debris flow, flooding
18	Huaraz	Ancash	1970-05	Earthquake - landslide of the Huascarán snow-capped mountain (ice and rocks) - avalanche - flood - flooding - soil liquefaction.
54	Huaraz	Ancash	2013-02	Huaico landslide due to heavy rains in the Pucaventana area, flooding the houses next to the stream. Collapse of passageways and rustic bridges
14	Achoma, Maca, Sigvas, Madrigal	Arequipa	2020-06	The damming of the Colca River due to the displacement of a large mass of earth, the reservoir reached more than 2 km upstream of the river, generating an immense risk in the Colca Valley, referring to agricultural areas, access roads, tourist areas and with a high degree of generation of more landslides. (https://www.planet.com/gallery/#!/post/landslide-on-the-rio-colca)
1	Camaná	Arequipa	2001-06	Earthquake generated tsunami that flooded part of the city, destroying lives and houses.
35	Tacna, Moquegua, Arequipa	Tacna, Moquegua, Arequipa	2020-01, 02 and 03	Activation of streams at various points in the regions of Arequipa, Moquegua and Tacna.
15	Cusco	Cusco	2020-02	On 23 February 2020, a mixed avalanche originated on the southwest face of the Salkantay snow-capped mountain, the material displaced on the Salkantaycocha lagoon generated waves. Subsequently, the outflow of the lagoon on the front side of the moraine or natural dam triggered a flood in the Salkantay river. The landslide covered about 38 km from the outlet to the mouth of the Vilcanota River (1485 m a.s.l.), widening the riverbed and eroding the bed of the Salkantay River, deepening it by up to 10 m in some areas. It affected the sectors Huayracmachay, Chaullay, Huiñaypoco. Palmaderayoc, Playa Sahuayaco, Cochapampa and Paltaychayoc; bridges, roads and farmland.
12	Machu Picchu	Cusco	2010	The floods destroyed: 1) the railway, the only means of communication to Machu Picchu, 2) tracks and paths near the river bank, 3) houses, hotels and restaurants, 4) the water and sewage system. The population and tourists were isolated and had to be rescued by helicopters for several days. The infrastructural and economic losses for tourism were devastating for the country's economy.

ID	Where did it happen (city)?	Where did it happen (region)?	When did it happen?	What had happened?
30	Cuenca	Huancavelica	2014-01	Landslide that dammed the waters of the Mantaro River, there was an interruption of the departmental road, railway line and loss of agricultural parcels due to flooding.
17	Chincha, Pisco	Ica	2007-08	After the Pisco earthquake, a significant number of aftershocks followed. The 15 August earthquake also produced secondary effects such as landslides and a large number of soil liquefaction phenomena. This damaged the Pan-American Highway South, leaving the most affected cities such as Pisco, Chincha and Ica isolated. The earthquake produced a tsunami with a wave height of 10 metres in the town of Lagunillas. The tsunami advanced along the coast of the central region of Peru with the possibility of reaching the port of Callao with waves of average heights of 1 to 2 metres that flooded the coastal road and some human settlements located on the beach.
4	Ica	Ica	1998-02	There were landslides, which flooded the city of Ica.
51	Pisco	Ica	2007-08	The collapse of vital systems led to the slow relief of the injured and the population.
7	Pisco	Ica	2007-08	Earthquake-tsunami, road closures, collapse of bridges, power and sanitation services cut off.
10	Pisco	Ica	2007-08	Local tsunami, houses destroyed, public services disrupted
55	Pisco	Ica	2007-08	The earthquake caused the collapse of buildings and deaths of people, obstructions on roads, power outages and cuts in water and sewage services.
60	Pisco	Ica	2007-08	The earthquake had a magnitude of 8.8 mw, which caused destruction of homes, the absence of public services and the interruption of roads.
22	Chiclayo	Lambayeque	2017-02	Coastal El Niño phenomenon, heavy rains, pluvial flooding, collapse of the sanitation system, overflowing rivers, landslides, electrical storms, interruption of national, regional and local roads.
59	Chosica	Lima	2017-03	
16	Lima	Lima	2008	Increased flow of the Rimac river.
23	Lima	Lima	2017-01 to 04	El Niño phenomenon / Heavy rains, rock falls, mud and debris flows, mass movements, disruption of roads, destruction of houses, destruction/disabling of infrastructure, loss of life.
27	Lima	Lima	2017-03	Coastal El Niño phenomenon
43	Lima	Lima	2017-03	Heavy rainfall caused huaycos (mass movements), increased flow of the Rimac and Huaycoloro rivers, which destroyed part of SEDAPAL's infrastructure and affected the production of drinking water.

ID	Where did it happen (city)?	Where did it happen (region)?	When did it happen?	What had happened?
50	Lima	Lima	2017-03	Heavy rains due to the occurrence of the El Niño phenomenon. Growing and overflowing of rivers. Occurrence of landslides and mudslides produced a high presence of solids in rivers. The Callahuanca power station and electrical substation were flooded with sludge. There was power rationing for users for a period of 3 months.
56	Lima	Lima	2017-02	El Niño phenomenon
20	San Juan de Lurigancho	Lima	2017-03	Heavy rainfall in the upper part of San Juan de Lurigancho caused the Huaycoloro stream to overflow near the Rímac river, flooding several houses in the Campoy area of San Juan de Lurigancho.
37	San Juan de Lurigancho	Lima	2019-01	Breakage of the sewerage network. Effects: pollution, public services affected, sewage overflows, water and electricity services affected, people's health affected.
29	San Martín de Porres	Lima	2009-03	Overflowing of the Chillon river. Flooding of main avenue, clogging of sewage system, weakening of affected houses.
19	Ilo-Moquegua	Moquegua	2019-02	Heavy rainfall - river growing – flooding - destruction of water catchment and pipelines of the drinking water treatment plants.
5	Piura	Piura	2017-02 and 03	Fenómeno del Niño, lluvias torrenciales, inundación de la ciudad de Piura, Catacaos, Sechura, Sullana.
49	Cuyo Cuyo	Puno	1984-01	Alluvial avalanche buried 50% of the village centre with mud and stones, power cut, water and sewage systems cut.
45	Zarumilla	Tumbes	1998-02	As a result of heavy rainfall, there was erosion of agricultural soils and untimely losses of up to 500 thousand of lateral displacement, as well as the fall of main bridges, interrupting traffic.

1.4 Stakeholders in multi-risk communication

In the RIESGOS project we are exploring multi-risk scenarios originated by natural disasters with cascading effects on critical infrastructure. In the case study for the metropolitan area of Lima and Callao, the scenario starts with an earthquake that triggers a tsunami, which causes impacts on critical infrastructure (energy, water, transport, etc.).

Below are some of the actors already listed who were identified in the RIESGOS workshop which took place in Lima on 19 November 2019.

Table 1-6: Important actors in risk communication in Peru (Question: “From your viewpoint, which actors play an important role in risk communication?”)

Sector	Organisation	number
public (national)	INDECI Instituto Nacional de Defensa Civil	35
	PCM Presidencia del Consejo de Ministros	34
	CENEPRED Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres	33
	Ministries (MINSA, MIMP, MVCS, MTC, MIDIS, etc.)	31
	Fuerzas Armadas	19
	Policía Nacional	18
	CEPLAN Centro Nacional de Planeamiento Estratégico	17
	Cuerpo General de Bomberos Voluntarios	17
	Regulatory Authorities (Osinergmin, Osiptel, Ositran, Sunass)	14
	APN Autoridad Portuaria Nacional	8
	DINI Dirección Nacional de Inteligencia	5
public (regional)	Gobierno Regional del Callao	22
	MML Municipalidad Metropolitana de Lima	21
	Gobierno Regional de Lima	21
	IMP Instituto Metropolitano de Planificación	10
public (local)	Municipalidades Distritales	19
	Municipalidad Provincial del Callao	16
	Municipalidad Provincial de Cañete	9
Companies (private or public)	Media (TV, Radio, Newspaper)	29
	Water company (SEDAPAL)	24
	Electricity companies (ENEL-Edelnor, Luz del Sur)	21
	Telecommunication companies (América Móvil, Entel, Telefónica)	19
	LAP Lima Airport Partners	10
	Companies in the Callao port	9
	CORPAC Corporación Peruana de Aeropuertos y Aviación Comercial	8
	COES-Sinac Comité de Operación Económica del Sistema Interconectado Nacional	5
Research	Research institutes (CISMID, IGP, IGN, INGEMMET, SENAMHI, DHN, etc.)	25
	Universities (UNI, UNMSM, UNFV, PUCP, etc.)	16
Non-governmental organisations (NGOs)	Cruz Roja Peruana	12
	PREDES, ITDG, COSUDE, etc.	10
Civil society organisations (CSOs)	CIP Colegio de Ingenieros del Perú	12
	Juntas de Usuarios de Agua / Juntas Administradoras de Saneamiento	5
	Neighbourhood associations etc.	2
International cooperation	e.g. UNDP, GIZ	13

Risk communication of such an earthquake-tsunami scenario, from prevention to recovery, involves different stakeholders who apply communication measures/actions (public authorities, scientists, the media) and other stakeholders (individuals, groups or organizations) who are interested or affected.

For the RIESGOS research on risk communication, we would like to know your assessment of the stakeholder's roles in an earthquake-tsunami scenario.

Table 1-7: Stakeholder's role in an earthquake-tsunami scenario (Question: "What is the main role you would assign to the actors within a risk communication process?" Ranking by number of entries)

Main role	Organisation	Number of entries
Process organiser	PCM Presidencia del Consejo de Ministros	31
	CENEPRED Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres	14
	INDECI Instituto Nacional de Defensa Civil	13
	CEPLAN Centro Nacional de Planeamiento Estratégico	9
	Ministries (MVCS, MTC, MINSA, MINAM, etc.)	8
	Gobierno Regional del Callao	6
	MML Municipalidad Metropolitana de Lima	5
	Municipalidad Provincial del Callao	5
Expert (information source)	Research institutes (CISMID, IGP, IGN, INGEMMET, DHN, etc.)	21
	INDECI Instituto Nacional de Defensa Civil	19
	CENEPRED Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres	17
	Ministries (MVCS, MTC, MINSA, MINAM, etc.)	10
	Water company (SEDAPAL)	9
	Universities (UNI, UNMSM, PUCP, etc.)	9
	CEPLAN Centro Nacional de Planeamiento Estratégico	7
	Electricity companies (ENEL-Edelnor, Luz del Sur)	7
	CIP Colegio de Ingenieros del Perú	7
	Regulatory Authorities (Osinerghmin, Osiptel, Ositran, Sunass)	6
	IMP Instituto Metropolitano de Planificación	6
	Telecommunications companies (América Móvil, Entel, Telefónica)	6
	International cooperation organizations (e.g. UNDP, GIZ)	6
	NGOs (PREDES, ITDG, etc.)	6
Multiplicator / knowledge broker	Media (TV, Radio, Newspaper)	24
	Gobierno Regional de Lima	12
	Ministries (MVCS, MTC, MINSA, MINAM, etc.)	10
	Fuerzas Armadas	10
	Gobierno Regional del Callao	10
	MML Municipalidad Metropolitana de Lima	10
	Policía Nacional	10

Main role	Organisation	Number of entries
	Cuerpo General de Bomberos Voluntarios	9
	Telecommunications companies (América Móvil, Entel, Telefónica)	8
	Municipalidades Distritales	8
	Cruz Roja Peruana	7
	Universities (UNI, UNMSM, PUCP, etc.)	6
	International cooperation organizations (e.g. UNDP, GIZ)	5
Affected / concerned	Water company (SEDAPAL)	8
	Electricity companies (ENEL-Edelnor, Luz del Sur)	6
	Telecommunications companies (América Móvil, Entel, Telefónica)	5
	Municipalidades Distritales	4
	LAP Lima Airport Partners	4
	Companies in the Callao port	4

2 Online Survey on Critical Infrastructure

Time period of the survey: between September 29th and October 30th

Number of valid responses: 16

Survey tool: LimeSurvey

2.1 Get started: data and working experience

Table 2-1: Sectors where respondents are currently employed (Question: “To get started, we would like to know in which sector you are currently employed.”)

Answer	Number	Percentage
public sector	11	68,75%
private sector	3	18,75%
university or research institute	1	6,25%
non-governmental organization (NGO)	0	0,00%
international development cooperation	1	6,25%
private person (consultant, etc.)	0	0,00%
others /no answer	0	0,00%

Table 2-2: Working area of respondents (Question: “In which area are you currently working?”, multiple answers possible)

Answer	Number	Percentage
administration	0	0,00%
planning	2	12,50%
disaster risk management	7	43,75%
civil protection	1	6,25%
housing and construction	1	6,25%
water and sanitation	1	6,25%
energy supply and distribution	3	18,75%
health	0	0,00%
telecommunication (telephone, radio, TV)	0	0,00%
transport	1	6,25%
research and consultancy	2	12,50%
education and training	0	0,00%
other	0	0,00%

Table 2-3: Specific areas of risk management of those participants that work in disaster risk management (Question: “Which areas of risk management are part of your work?”, multiple answers possible)

Answer	Number	Percentage
risk assessment	4	57,14%
risk prevention and mitigation	6	85,71%
risk preparedness and response	2	28,57%
risk recovery and reconstruction	2	28,57%
risk communication	2	28,57%
other → investigation	1	14,29%

Table 2-4: Administrative level of participants (Question: “On which administrative level are you working?”)

Answer	Number	Percentage
national level	12	75,00%
regional level	1	6,25%
local level	2	12,5%
neighborhood level	0	0,00%
other/no answer	0	0,00%

2.2 Strength factor of systemic criticality of selected critical infrastructures in Lima

Figure 2-1: dependence of selected infrastructure sectors on the electricity sector

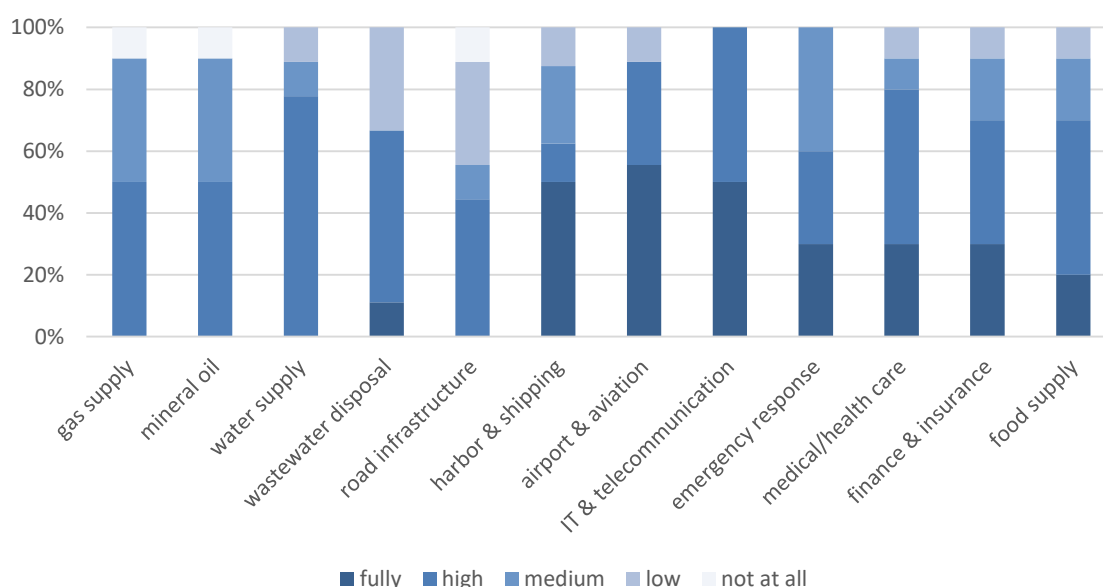


Figure 2-2: dependence of selected infrastructure sectors on the gas supply sector

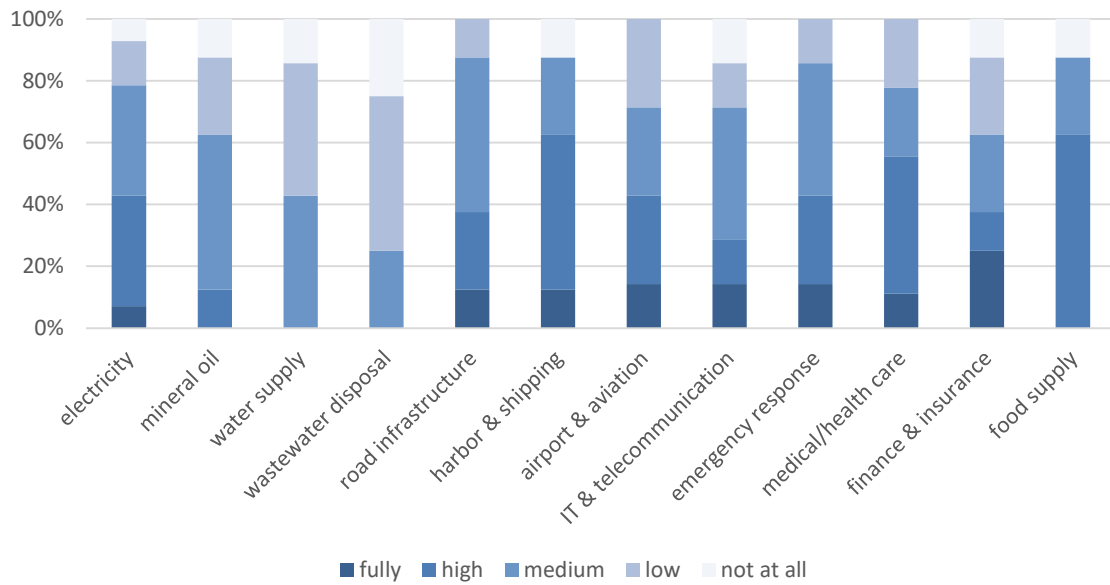


Figure 2-3: dependence of selected infrastructure sectors on the mineral oil sector

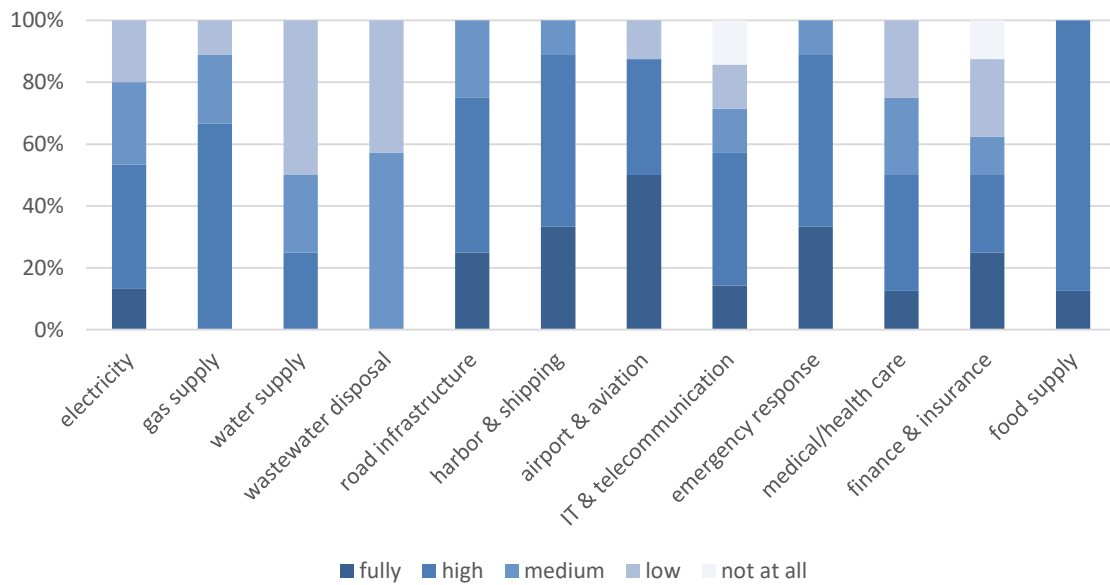


Figure 2-4: dependence of selected infrastructure sectors on the water supply sector

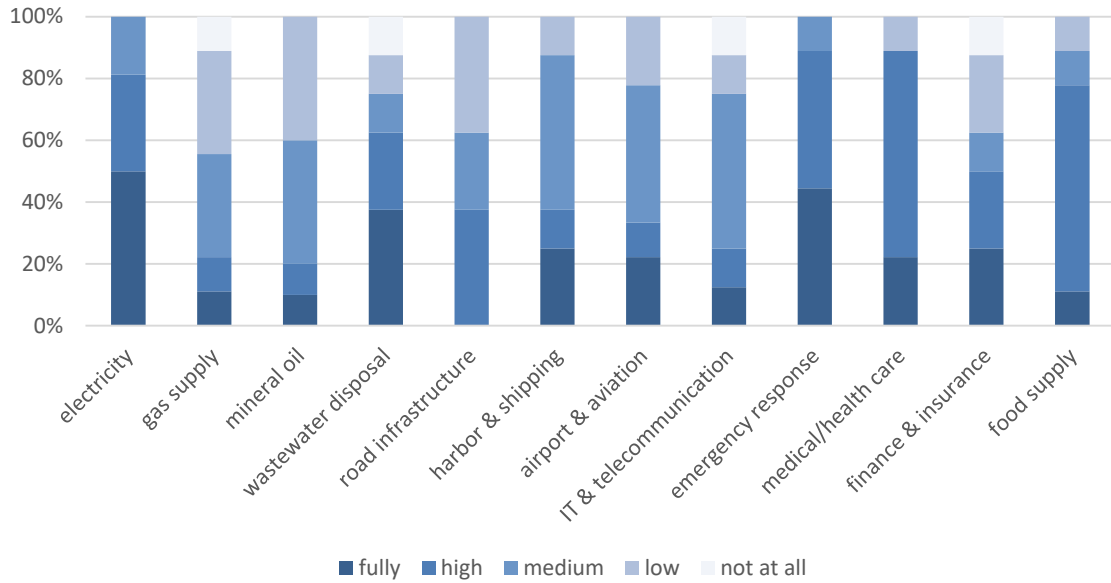


Figure 2-5: dependence of selected infrastructure sectors on the wastewater disposal sector

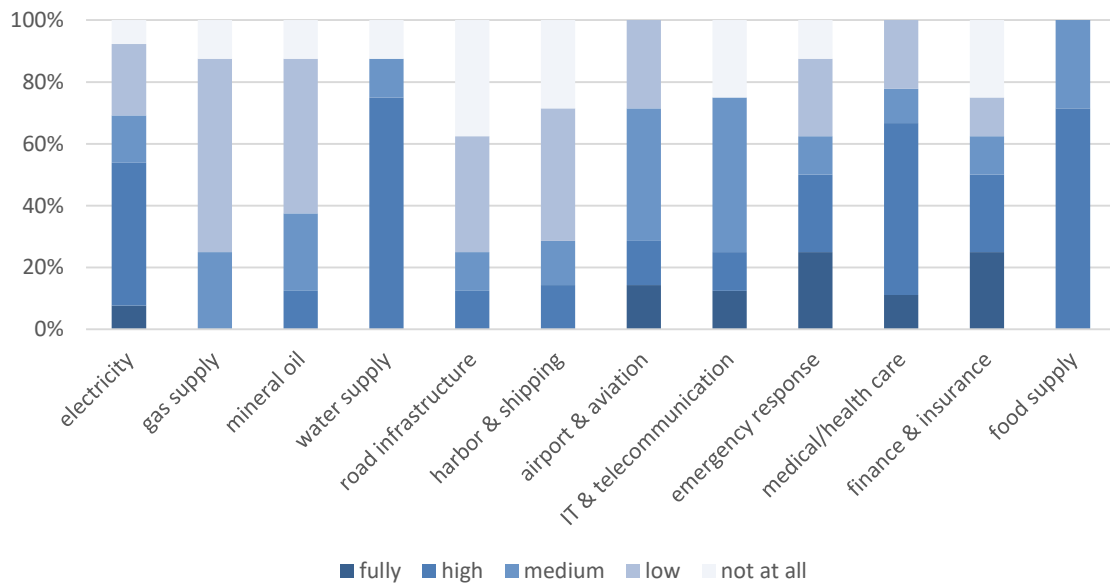


Figure 2-6: dependence of selected infrastructure sectors on the road infrastructure sector

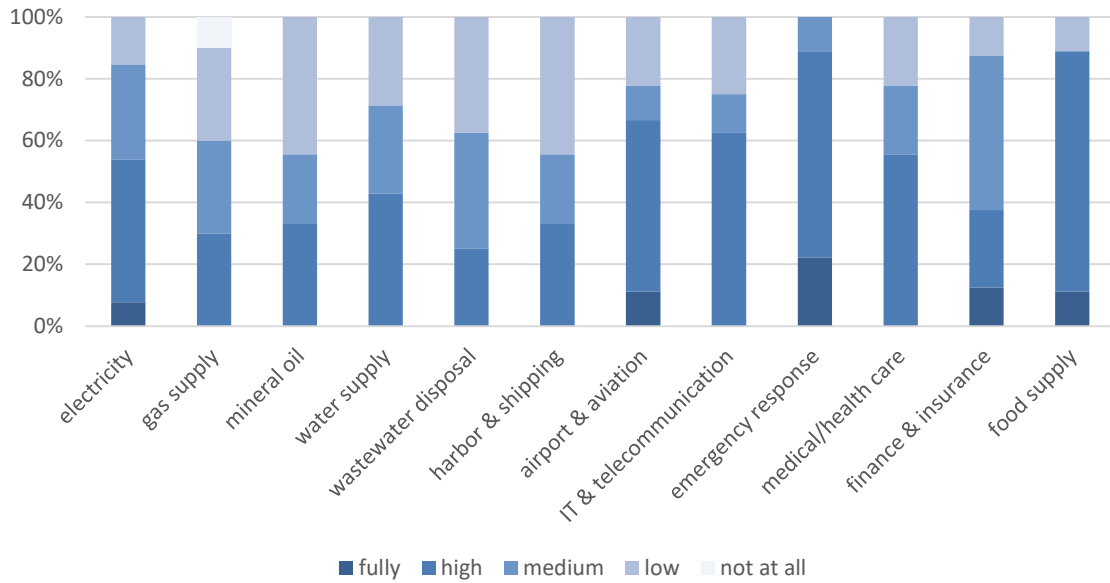


Figure 2-7: dependence of selected infrastructure sectors on the harbor & shipping sector

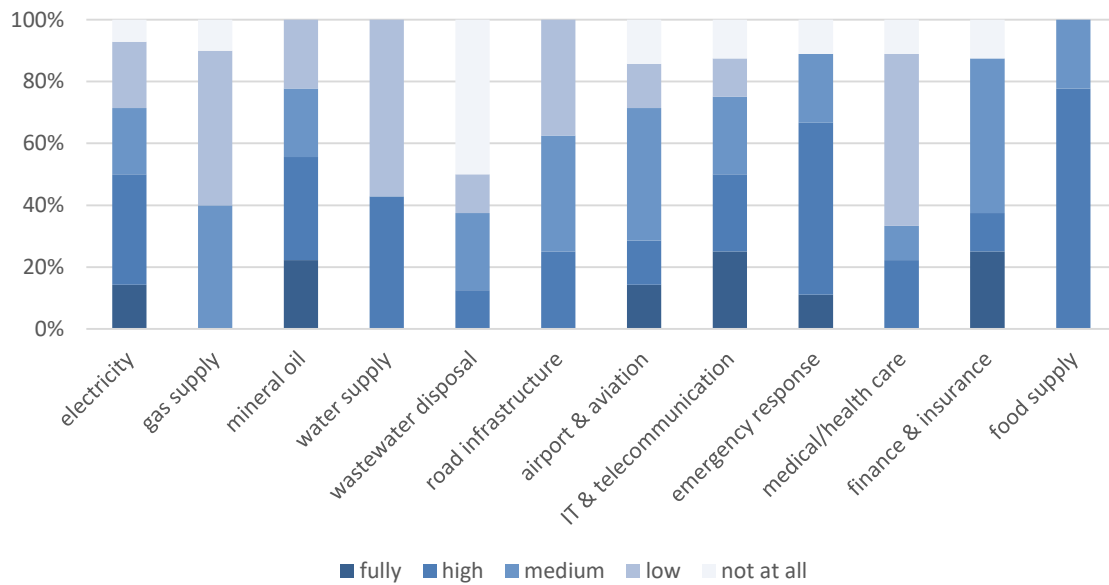


Figure 2-8: dependence of selected infrastructure sectors on the airport & aviation sector

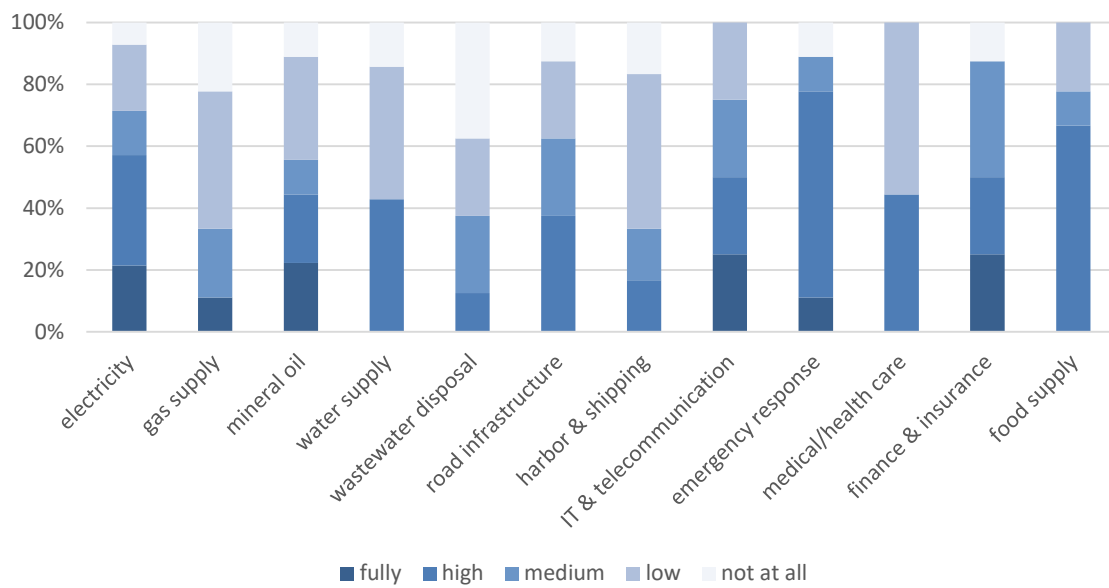


Figure 2-9: dependence of selected infrastructure sectors on the IT & telecommunication sector

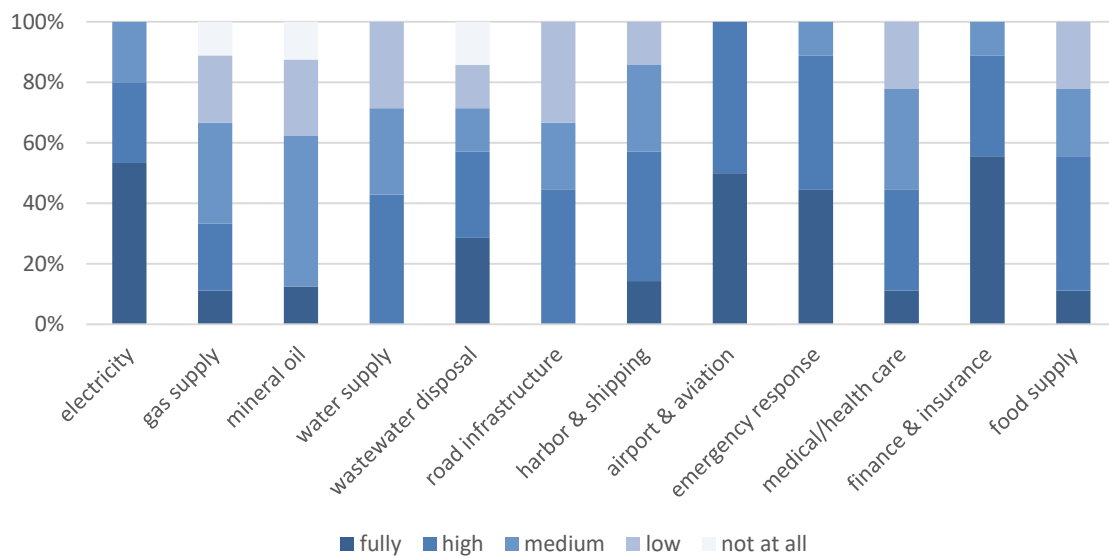


Figure 2-10: dependence of selected infrastructure sectors on the emergency response sector

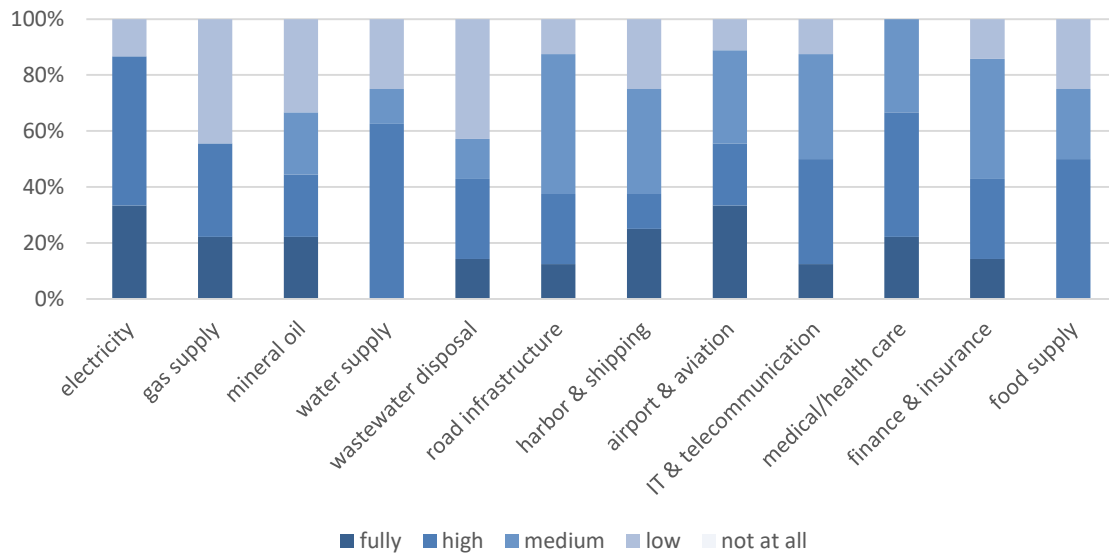


Figure 2-11: dependence of selected infrastructure sectors on the medical/health care sector

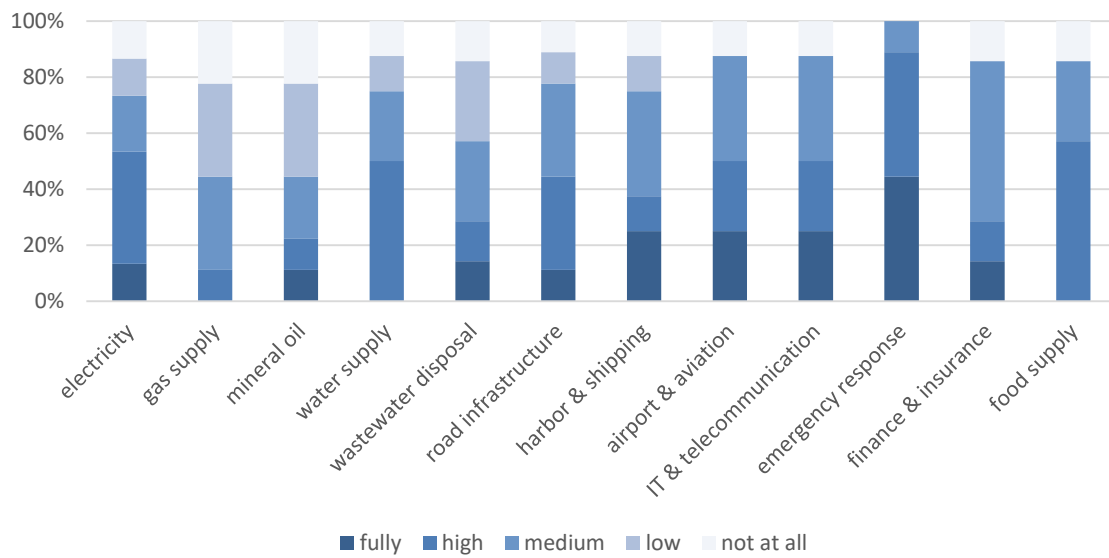


Figure 2-12: dependence of selected infrastructure sectors on the finance & insurance sector

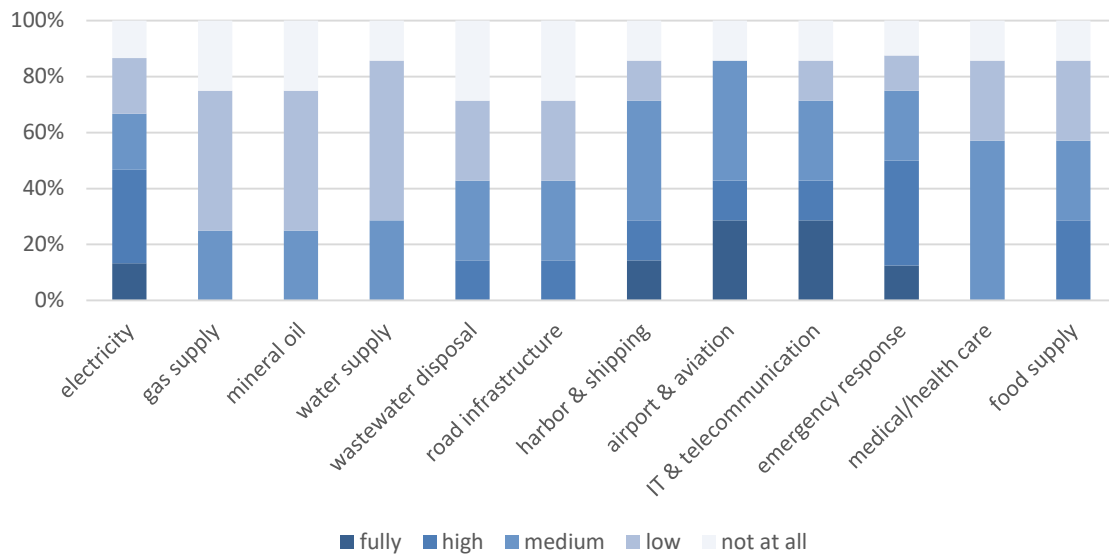
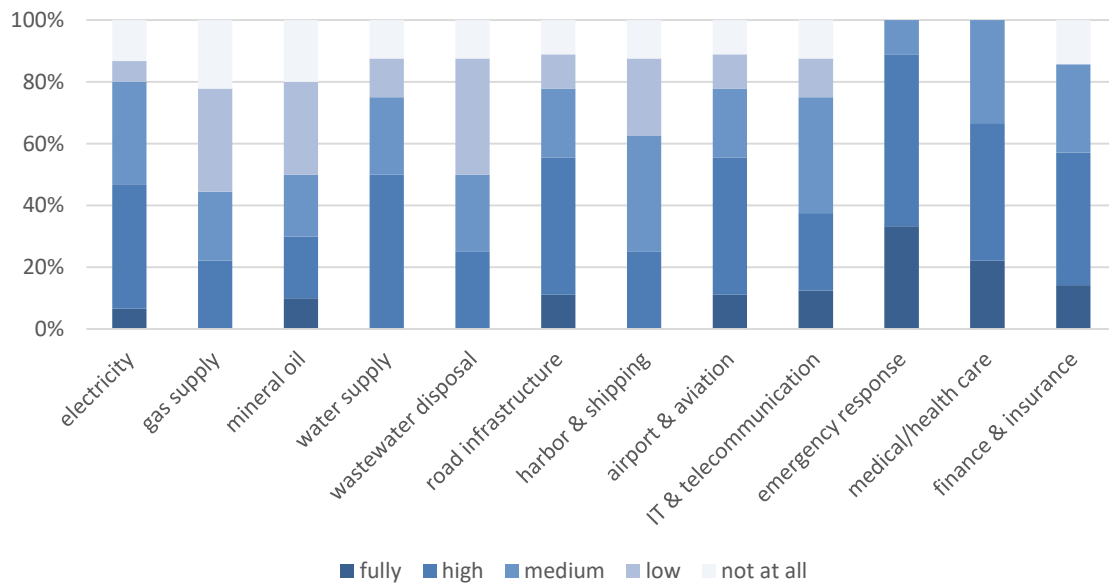


Figure 2-13: dependence of selected infrastructure sectors on the food supply sector



2.3 Time factor of systemic criticality of selected critical infrastructures in Lima

Figure 2-14: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the electricity sector?

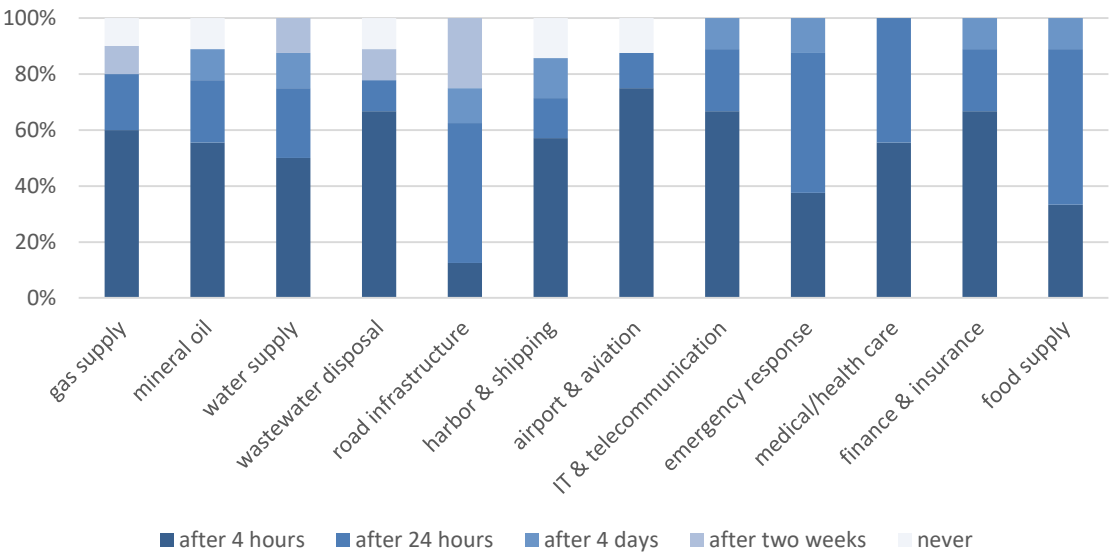


Figure 2-15: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the gas supply sector?

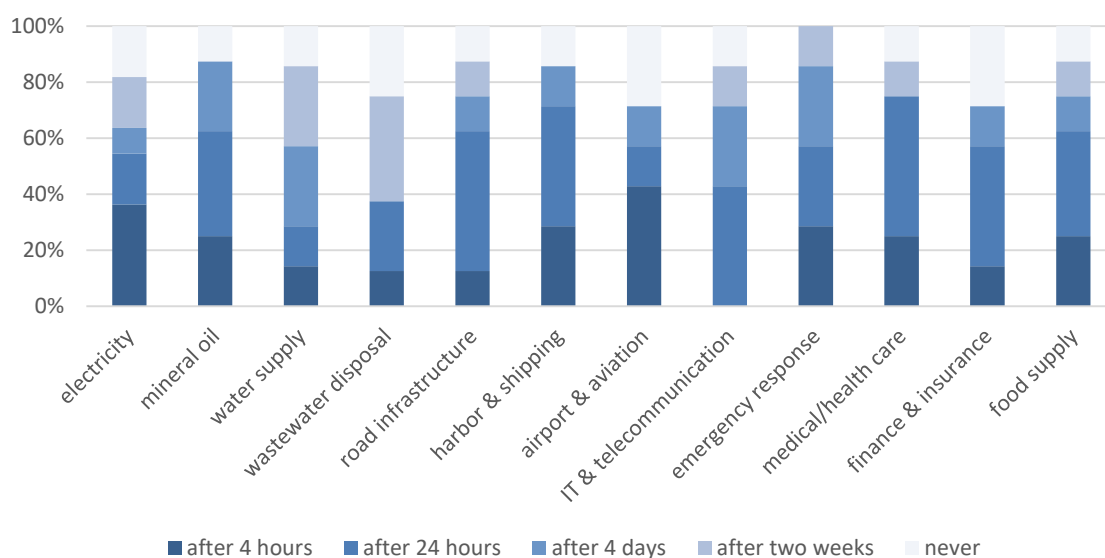


Figure 2-16: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the mineral oil sector?

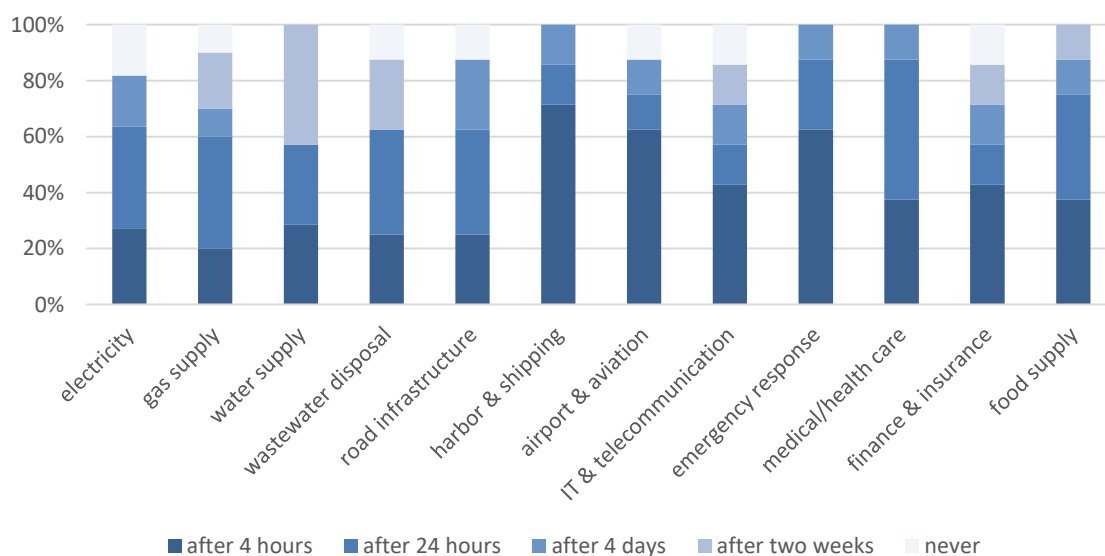


Figure 2-17: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the water supply sector?

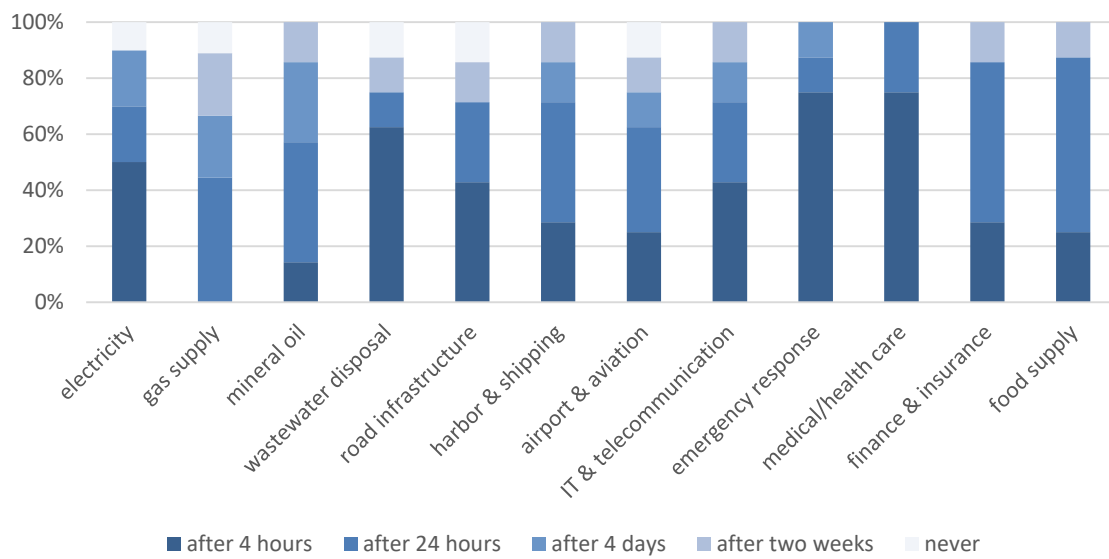


Figure 2-18: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the wastewater disposal sector?

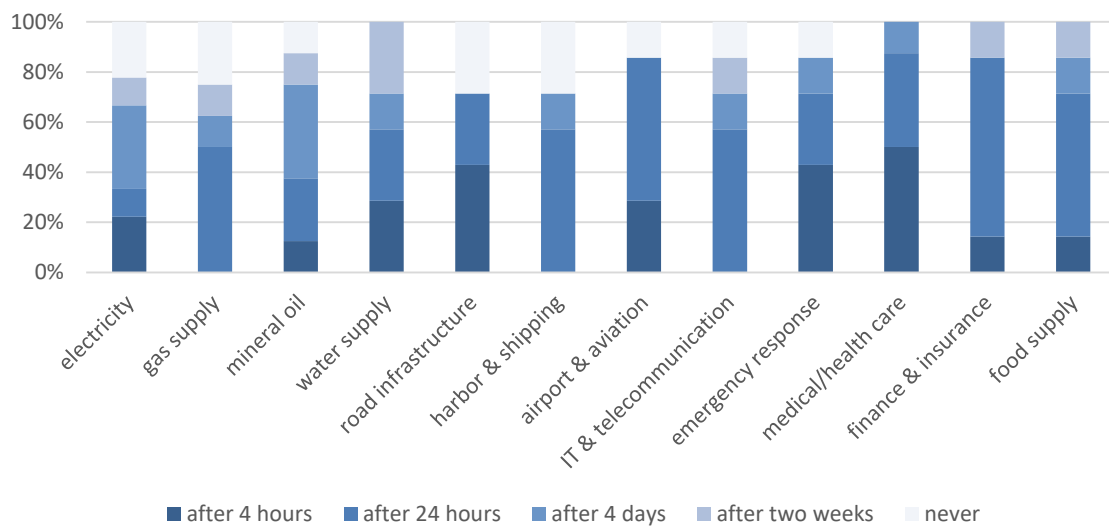


Figure 2-19: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the road infrastructure sector?

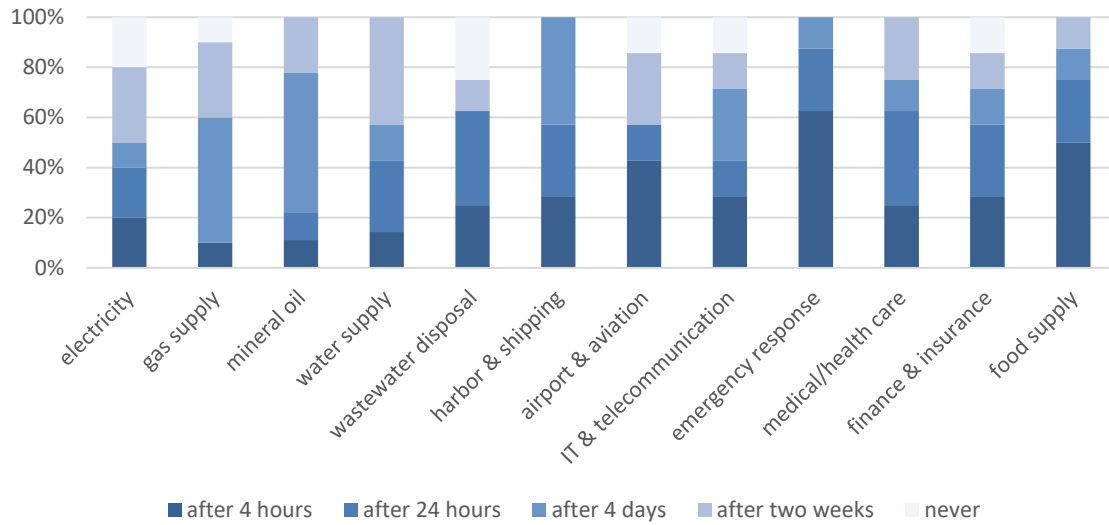


Figure 2-20: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the harbor & shipping sector?

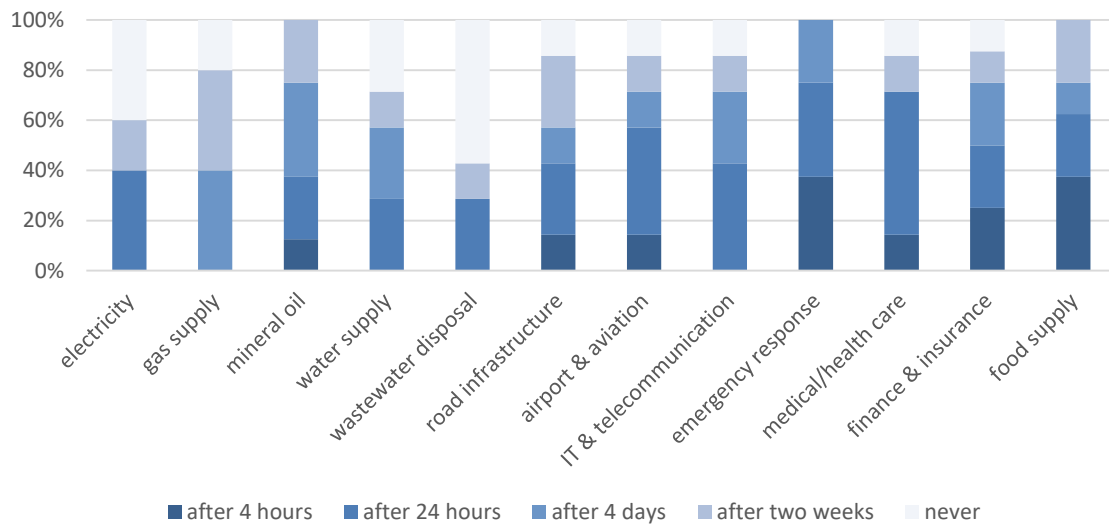


Figure 2-21: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the airport & aviation sector?

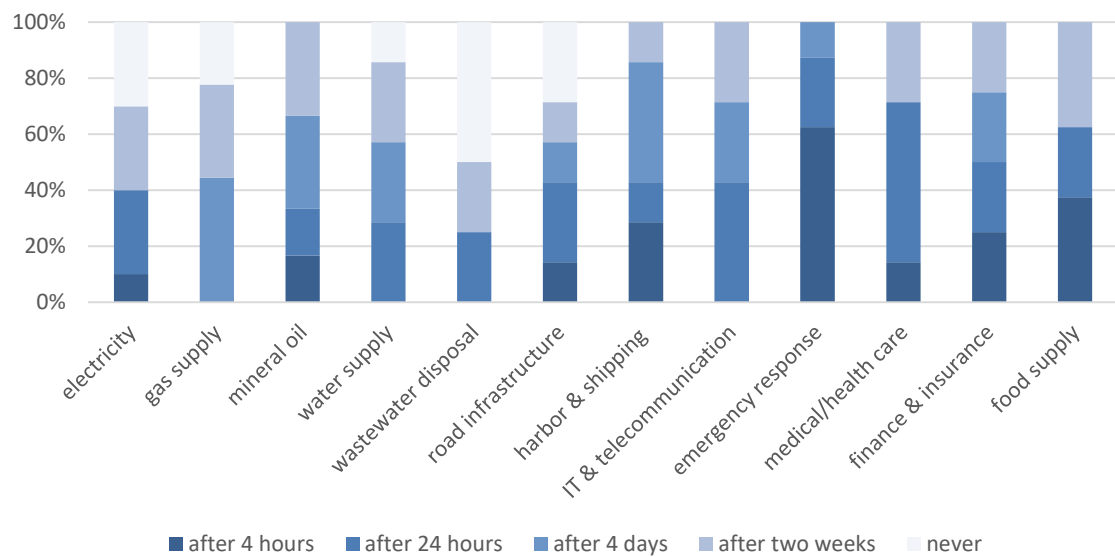


Figure 2-22: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the IT & telecommunication sector?

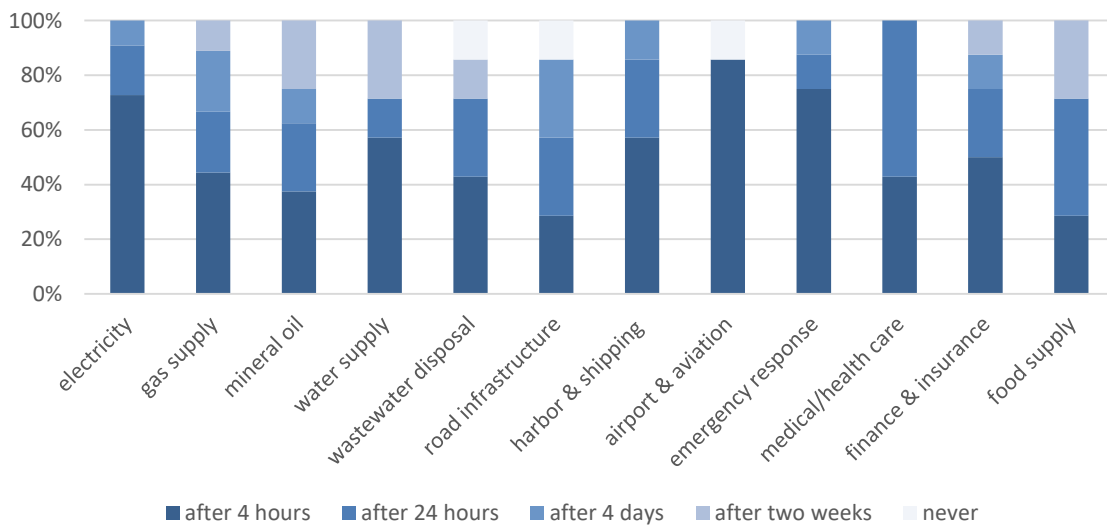


Figure 2-23: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the emergency response sector?

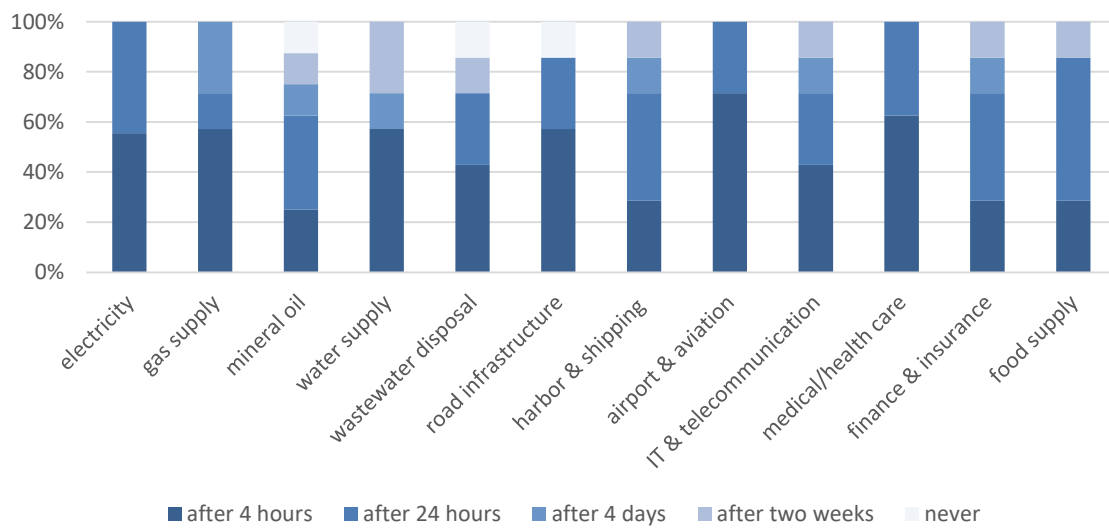


Figure 2-24: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the medical/health care sector?

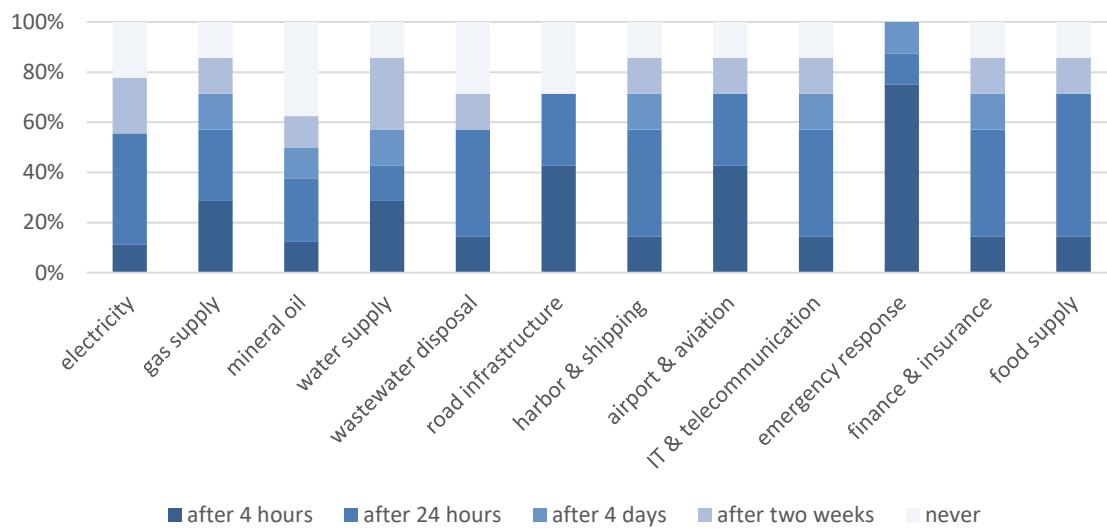


Figure 2-25: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the finance & insurance sector?

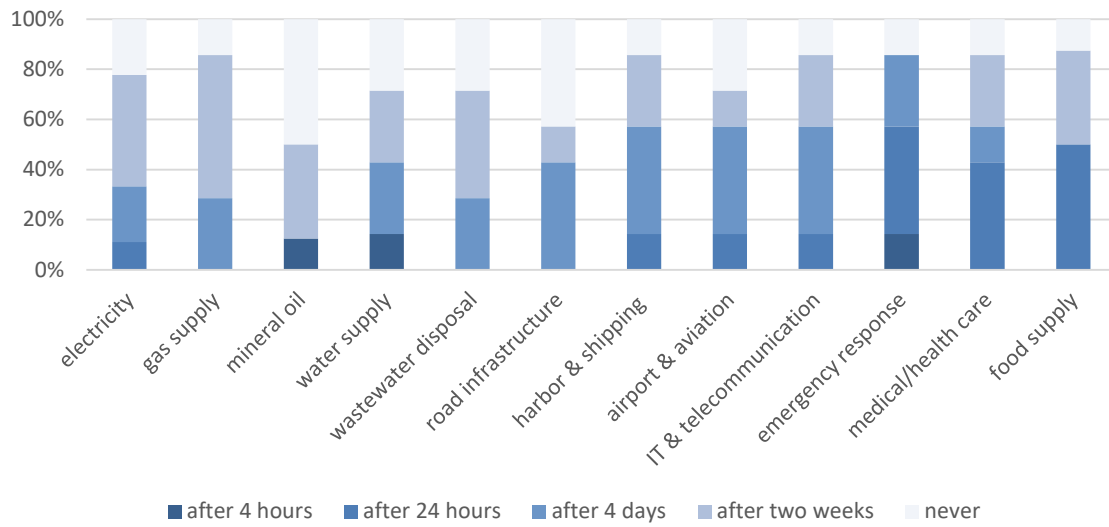


Figure 2-26: After which period of time would the operation of selected infrastructure sectors be heavily affected or failing because of a disruption of the food supply sector?

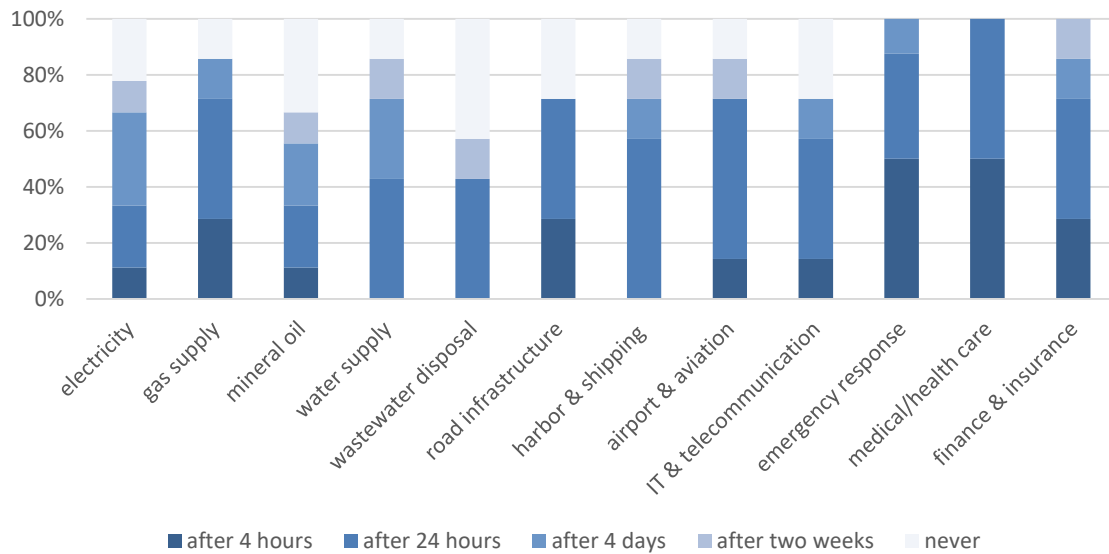
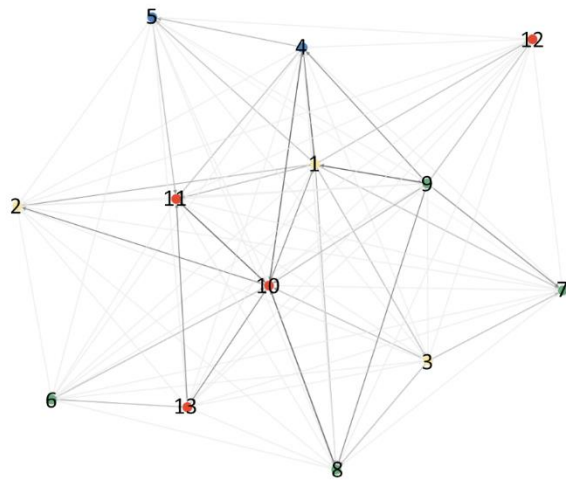
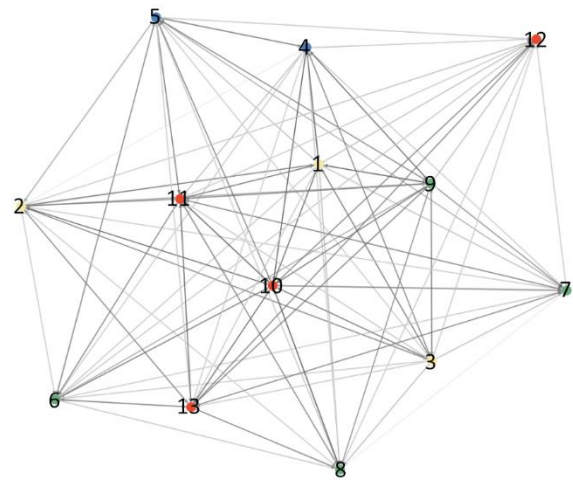


Figure 2-27: network graphic showing the time factors of selected infrastructure sectors in Lima

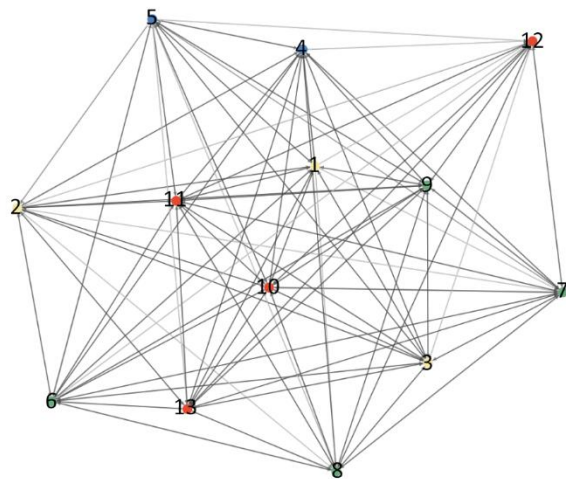
After 4 hours:



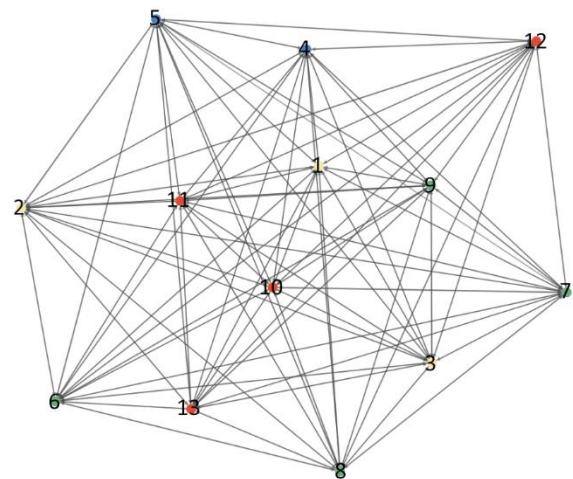
After 24 hours:



After 4 days:



After 2 weeks:



Sectors:	4 - Water supply	9 - IT & telecommunication
	5 - Wastewater disposal	10 - Emergency response
1 - Electricity	6 - Road infrastructure	11 - Medical & health care
2 - Mineral oil	7 - Harbor & shipping	12 - Finance & insurance
3 - Gas supply	8 - Airport & aviation	13 - Food supply

Legend (Figure 3)

