

## **Categorization of Critical Infrastructures and Critical Information Infrastructures**

<sup>1</sup>Furkhat Tadjibayev A. and <sup>2</sup>Feruza Sattarova Y.

<sup>1</sup>*Department of Management and Economics  
Tashkent University of Information Technologies  
Tashkent, Uzbekistan*

<sup>2</sup>*Department of Multimedia Engineering  
Hannam University, Daejeon, South Korea  
mymail6585@gmail.com*

### **Abstract**

*A research on current condition and problems of critical infrastructures and critical information infrastructures is described in this paper. This article includes issues, the discussion of problems and comments about each of the common Critical Infrastructures from an international, national, local and individual perspective. There are many threats to these infrastructures. And it remains a challenge to the society to deliver solutions to problems such as these. Also the situation in Korea on each sector of Critical Infrastructure is considered in the article.*

**Keywords:** *Critical Infrastructure; Critical Information Infrastructure; Energy; Finance; Food; Health; Law; Icon; Manufacture; People; Problem*

### **1. Introduction**

Regarding to the consistency provided by Dunn and Wigert [1] Critical Infrastructure Sectors are sectors whose incapacitation or destruction would have a debilitating impact on national security and the economic and social well-being of a nation. Critical infrastructure is a term used by governments to describe assets that are essential for the functioning of a society and economy. All of the critical infrastructures have one property in common—they are all complex collections of interacting components in which change often occurs as a result of learning processes; that is, they are complex adaptive systems. An infrastructure has cyber interdependency if its state depends on information transmitted through the information infrastructure.

So, common sectors of Critical Infrastructures are:

- Energy resources;
- Finance;
- Food;
- Health;
- Government services;
- Manufacturing;

- Law and legislation;
- National icons;
- Transportation;
- People and education;
- Intellectual property.

Critical Information Infrastructures are the totality of interconnected computers and networks and their critical information flows. It includes telecommunications, computers, software, the Internet, satellites, fiber-optics and etc.

## 2. Survey on Critical Infrastructure and Critical Information Infrastructures

### 2.1. Energy Resources

Geologists tell that stocks of oil and gas are running out and there are no more to be found. It can lead to this, that the world's economy will become destabilized and war will replace trade as the only reliable way for nations to secure enough food, water, and energy for themselves. A rush for coal has been predicted. Nuclear energy has been the focus of much recent attention for future sustainable energy. *At an international level* the competition for resources are breathtaking in an historical context. Russia has virtually nationalized a joint venture with Shell in Sakhalin and effectively turned off gas and oil supplies to various parts of Europe some years ago; both actions would have been the cause for war a century ago. China is exercising a diplomatic offensive around the world in a bid to win resources from the west to meet its own requirements. This competition is trampling on nuclear treaties, human rights agreements, humanitarian developments, and views in ways that have not been seen for decades.

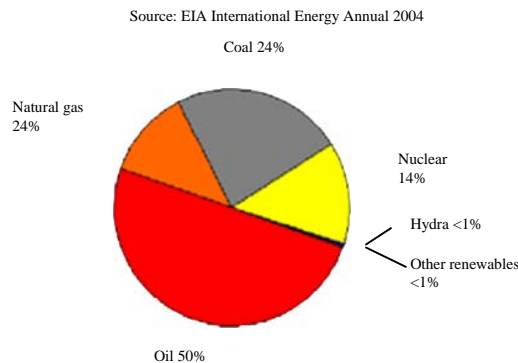


Figure 1. Total energy Consumption in South Korea, by type

*In national level (UK)* there has been a shift from self-sufficiency on energy resources from the North Sea and Atlantic Ocean to dependency. Now dependency is based on unreliable energy resources from Eastern Europe and Siberia. *At local and individual level* the increasing demand for energy in all parts of the world puts increasing pressure on relatively scarce international and national resources. The sustainable use of timber, wind, and alternatives to electricity are technologies and skills that have not received the same

technological and developmental input as fossil fuel derived energy sources, with one or two exceptions. Thus resilience in energy is probably at an all time low.

**Energy resources in Korea.** With limited domestic energy resources, South Korea is almost entirely dependent on imports to meet its energy consumption needs. South Korea is the fifth-largest net importer of oil in the world, and a significant importer of liquefied natural gas (LNG). Coal is South Korea's second-largest source, supplying 24 percent of primary energy consumption needs in 2004, followed by modest contributions from nuclear power (14 percent) and natural gas (12 percent). [2].

## 2.2. Finance

For four decades, insurance losses have been rising at 10% a year. If this continues by around 2060 wealth will be destroyed faster than it can be created. Global warming will be a significant issue here. The possible extent of losses caused by extreme natural catastrophes in one of the world's metropolitan or industrial centers would be so great as to cause the collapse of the world's financial markets. *At an International level* the competition for finance remains fierce. The China surplus has been used to buy USA treasury bonds, this in turn finances the USA debt. This effectively puts China in a strong position to control the health of the USA economy. This situation may be one of the defining issues of the twenty-first century, because the future success of the OECD economy is inextricably linked to it. *In national level (UK)* the health of the City of London is based on international finance and insurance. This driver has a particularly significant effect on housing, land prices, and retail sales. The second key concern is the grounding of the UK economy in property wealth. This is threatened by difficulties in the international money and insurance markets, and collapse in world markets. *At a local and individual level* it remains the case that financial health depends upon the ability to compete in world markets. This is increasingly under threat from relatively high taxation.

**In South Korea** increasing oil prices are fanning inflation and boosting costs to businesses and consumers in an economy that imports 97 percent of its energy needs. Exports may slow as the U.S. housing recession cools the expansion of the world's biggest economy, damping global growth.

## 2.3. Food

Food, after water, is the most important human need. As there are now more obese people in the world than there are malnourished then part of the problem is clearly one of political will, distribution, and management. Equally worrying is climate change. Climate change is having a vast, and quick, effect on food supplies. *At an international level* world market prices for major food commodities such as grains and vegetable oils have risen sharply to historic highs—more than 60 percent above levels just 2-3 years ago (2006-2007). Retail food prices in many countries have also risen in the last 2 years, raising concerns around the world. Figure 2 charts the price index for food commodities along with an index for the average of all commodities and an index for crude oil. Although the food commodity index has risen more than 60 percent in the last 2 years, the index for all commodities has also risen 60 percent and the index for crude oil has risen even more [3].

At a national level food supply is dominated by the supermarkets. The average amount spent by the UK household on food has halved in a generation, in real terms, and the quality has undoubtedly risen. *Locally and individually* the main problem, again, is the lack of local food sources and the increasing inability of individuals, or even those with the knowledge, to

grow food. During the Second World War almost all members of the UK population grew some food of their own, allotments dropped by 50% in the 1970s and 1980s and despite a halt in decline, less than 5% of the population grows any of their own food. Thus resilience in terms of food is under threat.

Source: International Monetary Fund: International Financial Statistics

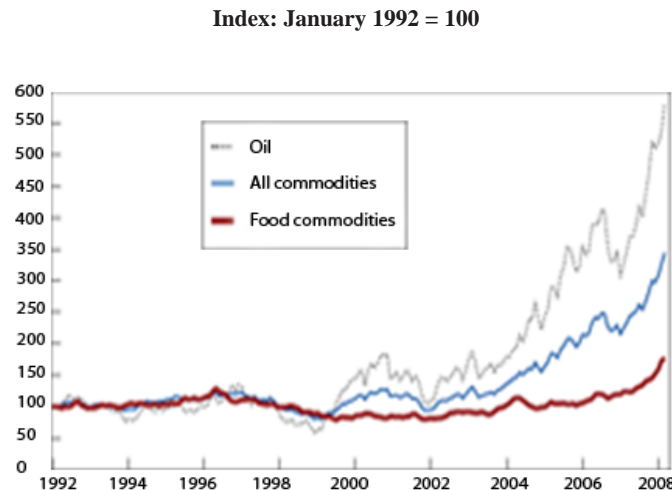


Figure 2. Prices of many commodities rose [4]

**The food shortage in North Korea** is getting worse. The Agricultural Organization of the United Nations (FAO) said a “sharply below-average cereal harvest in 2007 led to an estimated cereal deficit for the 2007/08 marketing year of 1.66 million tons.” [5]

Experts on North Korea and North Korean refugees in South Korea say the situation is similar to the mid-1990s, when the country was hit by famine that left anywhere between half a million and 3 million people dead. A source said the price of a kilogram of rice, which stood at 1,100 North Korean won at the end of last year, rose to 2,500 won, which is the monthly salary of an ordinary laborer. During the mid-1990s, people died of hunger after the price of rice skyrocketed to the level of a monthly wage and public food distribution was terminated. The best and the easiest way for North Korea to obtain food is to improve relations with the South, but experts predict the North will continue to hold out.

## 2.4. Health

Health is not obviously a problem for the OECD countries, with death rates in all age groups at arguably the lowest level ever. However, a number of factors give rise for some concern on health too. One is overall hygiene and cleanliness and another is the immune system. Immune systems are prevented from developing because of emphasis on the wrong sort of cleanliness and hygiene in the young. The second is personal weight control. Obesity in the western world tops more than 25% of the population. *Internationally* the polio and avian flu has new outbreaks in Nigeria and elsewhere, so there is not any complacency on health. The increasing failure of antibiotics on a world level to deal with bacterial infections and the difficulty in treating old and new viruses, compound the problem. The international outlook for health is not necessarily good. *At a national level* health is rapidly becoming a problem. All the difficulties noted above can generally be found in the UK. The standard of health of the nation’s youngsters is poor. The cause of this is a mixture of poor personal

health, eating and drinking disorders, drugs, lack of exercise and a view that all ills can be cured by the National Health Service. On top of all of this Global Warming brings the return of tropical diseases. *At a local and individual level* the young population has less idea of how to look after themselves than their parents, and is demonstrably less healthy. Thus resilience in terms of health can be said to be under threat.

**Health in South Korea.** Although life expectancy has increased significantly since 1950, South Korea faces a number of important health-care issues. Foremost is the impact of environmental pollution and poor sanitation on an increasingly urbanized population. According to the Ministry of Health and Welfare, chronic diseases account for the majority of diseases in South Korea, a condition exacerbated by the health care system's focus on treatment rather than prevention. The incidence of chronic disease in South Korea hovers around 24 percent. Approximately 33 percent of all adults smoke. The human immunodeficiency virus (HIV) rate of prevalence at the end of 2003 was less than 0.1 percent. In 2001 central government expenditures on health care accounted for about 6 percent of gross domestic product (GDP) [6].

## 2.5. Government Services

At an international level "government" services are provided by the major multilateral organizations, and by the federations. None of these have a particularly strong reputation for resilience under pressure. The most effective are probably the OECD and NATO. *In national level (UK)* government services ensure the continuation of society on a day to day basis. The resilience of Government services, and certainly some local government infrastructure services, is under threat. There is no effective defense organization for Critical Infrastructures and Critical Information Infrastructures.

**E-Government in Korea.** The Republic of Korea's growing internet population is an important step towards the country's e-government efforts. In Korea, there is a strong awareness that an ICT literate citizenry is needed to make full use of the Government's online efforts, which have been bold and far-reaching.

## 2.6. Law

At an international level "government" services are provided by the major multilateral organizations, and by the federations. None of these have a particularly strong reputation for resilience under pressure. Law and order in the context of Critical Infrastructure means a number of things. It means:

- the continued existence and prevalence of law and order;
- the continued ability to make laws and maintain order in a democratic society;
- the ability to enforce laws and orders;
- the consent of society to be governed by those laws and orders.

There is no effective international position on law and/or order with regard to Critical Infrastructures. No negotiations, no treaties, exist that specifically cover Critical Infrastructures in an international context.

At a national level in the UK much legislation regarding Critical Infrastructure is related to antiterrorist legislation. Some bilateral activity has taken place. The USA has enacted legislation that has some international reach. *At a local and individual level* the preservation of law and order is more often about confidence than the law and order itself.

**Law and Legislation in Korea.** Information-security promotion systems in Korea can be divided into national cyber-security systems, e-government security systems, critical information infrastructure systems, and private information security systems. With respect to the national cyber-security system, the “National Cyber Security Management Regulation” was issued by a presidential directive on 31 January 2005, which regulates cyber-security organizations such as the National Cyber Security Strategy Council or the National Cyber Security Center. Meanwhile, for e-government security systems, the “Act on Promotion of Electronic Administration for e-Government”, enacted on 28 February 2001, regulates matters of information protection as well as e-government.

## 2.7. Manufacturing

Much ground is being made up in terms of awareness and understanding, but no real new economic resource has been put behind this (especially when compared to expenditure on Iraq, for example).

David Hensley, Director of Global Economics Coordination at JPMorgan, said: "The downturn of global manufacturing became broader and deeper in August, 2008. Although it is worth nothing that part of this reflects the temporary effect of the Olympics on Chinese output, domestic markets remained weak in most of the nations covered and the growth base of international trade is becoming increasingly narrow. The sharp easing in cost inflation is a welcome development that will hopefully continue as commodity prices recede from historical peaks."



Figure 3. JPMorgan global manufacturing PMI [7]

In International, National, Local, and Individual terms the threat from the east to the manufacturing base of the west is severe. There is some hope that the core elements of research and development may remain – but if the figures coming out of China and India for qualified graduates are maintained then even this must be considered under threat. Thus without the manufacturing base, and without trained personnel, there is little hope that added value can continue to be added in a manufacturing sense over the long term. The resilience of manufacturing is clearly under threat in the west, and OECD in general.

## 2.8. Icons

Icons are important. They give a sense of place and identity. The removal of the Berlin Wall signified the end of a divided Europe. *Internationally* icons may seem to have little relevance. However, there are some international icons: world heritage sites; the Antarctic; Mecca; Canterbury Cathedral, and the Vatican that define all of us as a civilized race. The

destruction of international icons represents a failure in international cohesion. So important are they that there have been agreements between enemies to preserve particular icons.

Nationally icons are very important. They are symbols of a nation, of a society, and of a region. The loss of one or all represents a change for the worse in the national psyche. A review of Yale's Avalon Project indicates that an update of the Hague Conventions is required in a number of areas. Even with an update, how does international law deal with attacks on national icons that are not committed by members of nation states? This is a recurrent problem in today's world.

## 2.9. Transportation

Internationally the expansion of land, sea, and air transport systems characterizes political stability and open economic trading agreements. The existence, and preservation, of international transportation links is a good proxy for resilient societies. *Nationally*, the state of country's transportation system can be an equally good proxy for the state of the nation. Resilient countries must, by definition, have good transportation systems and good alternatives to systems when they break down. *Locally and individually* the ability to survive without reliance on the road system in particular is also of concern. The privatization of both the rail and public road transportation systems in the UK cut off many communities. The basis of the individual's ability to live in today's society, outside of the big cities, is defined by the need for a motorized vehicle and fuel. Individuals can no longer take a bike, or walk, to work, simply because they live too far from their work.

**Transportation in South Korea.** The nation's capacity to transport people and goods (domestic and international) has increased rapidly with the growth of the Korean economy. Transportation in South Korea is provided by extensive networks of railways, highways, bus routes, ferry services, and air routes that criss-cross the country. South Korea has an excellent railroad network. [8]

## 2.10. Water

Water is probably second, if not equal, to oil as a source of international conflict. Investment in water distribution is no longer something carried on through the taxation system for the benefit of all citizens – but something that is left to the vagaries of the market. A shortage of water stems the flow of oil and foreign exchange: it is essential to both the extraction and treatment of the mineral. Water can thus be said to be the most valuable commodity in the Middle East today. The water resources of the UK have moved from public to private ownership over the last 50 years. The owners are, more often than not, non-UK companies. This means that the most basic human requirement, that of the provision of clean water, has been lost from national "ownership." Industrial effluent poisons rivers and seas, the disastrous effects of which have lasted for decades in Europe, since the industrial revolution, and are increasingly apparent in Russia, India, China, and South America.

Two additions to the list of Critical Infrastructures are proposed. These are people and education/intellectual property. Both the numbers and type of people are important in any society. The ability of countries such as China and India to deliver more than 10 times the number of graduates in computer related studies than some leading western countries (the UK, for example) means that there will be a shift of leadership at some stage from west to east. A highly educated workforce is likely to be a high value-added society.

## 3. Conclusion

The majority of the acknowledged Critical Infrastructures, and two additional ones in terms of people and education/IPR, are clearly under threat. It would be difficult to describe any of them as naturally resilient for a variety of reasons: political, economic, and social. This is of serious concern in societies that are under attack from various different sources at both the political and economic level in particular. Combined with known difficulties in most Critical Infrastructure areas the success of the Intelligence Agencies in apparently countering the threats to Critical Infrastructures should not be underestimated.

In this research work the current problems and the condition of critical infrastructures and critical information infrastructures are described. In our further research works we will propose solutions to the existing problems in these fields of area.

## Acknowledgement

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