NGI101x - Socio Complexity part I

Welcome back. In this video I will discuss the social dimension of the complexity of infrasystems. This social complexity interferes with the technical complexity, which we discussed in the previous video. Social and technical complexity result in a complex sociotechnical system.

Complex behaviour in the social part of the system arises from interactions between the actors operating in infrasystems.

The number of actors involved in infrasystems has grown significantly in recent years, and with it the variety of the actions and interactions. I will successively discuss the changes in the actor configuration, the actions these actors take and the resulting interaction patterns.

Until recently, social complexity was limited.

The production chain was characterized by the full integration of activities. All links in the production chain used to be integrated. This integration was justified by the fact that certain technical facilities – the networks – had the character of a natural monopoly. It was economically unacceptable to duplicate this infrastructure. In combination

with the integration of all activities, which was deemed necessary, this resulted in a vertically integrated monopolistic organization. In many countries these were public organizations, while in other countries, including the US, these were private organizations overseen by a regulator. I will present a number of change processes below, all of which resulted in an increase in the number of actors in infrasystems as well as their variety.

This all started to change in the 1980s.

The concept of unbundling was born.

Unbundling is the separation of activities and roles in the production chain, where possible, a vertical decoupling. In many infrastructures, a separation was applied between the operation of the infrastructure and the operation of the services provided over the infrastructure.

An example is railway companies, where the operation of the railways and the operation of train services are usually separated.

Such separations have also been implemented in the telecom industry and, to a lesser extent, in the energy sector.

The separation can take on many different forms. Mild forms include accounting separations, while the most severe forms are those in which completely different companies are responsible for these operations with the companies having nothing to do with one another legally, financially and as far as ownership is concerned.

After unbundling, it may turn out that competition is indeed possible in a number of links in the production chain. For example, competition is often possible at the level of

services provided over the infrastructure. However, in practice the number of competitors remains limited, with duopolies or oligopolies being frequently occurring market forms. Nevertheless, the number of players is increasing compared to the monopoloid configuration.

Competition was introduced in the electricity production chain at both the producer and supplier level, but often in oligopoloid configurations. The grids, high voltage grid and low voltage grid, remained monopolies.

Along with this unbundling and the introduction of competition, many of the relevant organizations were hived off from the government. In fact, a large number of players were privatized altogether, particularly in the links in which competition was introduced. In countries in which regulators were not yet active, the legislature often introduced regulators to monitor the markets and the hived-off or privatized actors.

This hiving-off operation resulted in an increase in the variety of actors, resulting in a more complex system as a whole.

Networks are increasingly linked across national borders to the networks in neighboring countries. This applies to rail networks, energy networks and telecom networks.

The internet has been a global network from the start. As a result of these transnational links, foreign players are also starting to play a role in the domestic networks. In addition, global players are emerging who, although initially based and legally administered in a particular country, in fact appear as truly global players. Examples include the major oil companies and Google.

The gradual development of a system of systems is an important factor in the increasing complexity of infrasystems. Previously separated infrasystems play a substantial role in facilitating the proper functioning of other infrasystems. For example, energy is an infrasystem that is essential for the proper functioning of other infrasystems. Without energy, transport is impossible! The internet has also become indispensable for many systems. And, of course, energy and the internet are mutually dependent on each other. There can be no internet without energy, of course, but the opposite is also true. As energy networks become smarter, they are increasingly web based. A failing energy supply or a failing internet operation will paralyze other infrastructures. This has two consequences. One: infrasystems are becoming smarter and smarter. Two: problems in one infrasystem are propagated to other infrasystems.

By convergence we mean that infrastructures that used to be dedicated to a product or service are finding more applications. Mono-functional infrastructures are becoming multifunctional. The electricity cable and the television cable can also be used for telephony or the internet. It goes without saying that convergence increases complexity. Because multiple types of services are provided over an infrastructure, you draw all the actors involved in those other services into the infrasystem's arena as it were. The number of actors grows significantly as a result and, because they have different backgrounds, the variety among the actors will also increase.

Thank you for your attention! The next lecture we will discuss what this means for the complexity of infrasystems.