UiS foredrag torsdag 199. april 2007, 14.15 -15.30, Kjell Hausken
UiS Lecture Thursday April 19, 2007, 14.15 -15.30, Kjell Hausken

Spillteori og risikoanalyse
Game Theory and Risk Analysis

Konvensjonell operasjonsanalyse, risikoanalyse, pålitelighetsteori, og sannsynlighetsteori har den begrensning å anta spill mot statiske, fikserte, og uforanderlige faktorer som er eksogent gitt. Det er behov for å betrakte spill mot adaptive, strategiske, optimiserende, dynamiske aktører. Foredraget starter med de enkleste spill. Fangens dilemma, battle of the sexes, chicken spill, koordineringsspill. Trusler mot infrastrukurer skyldes natur, teknologi, og intensjonelle aktører. Betydningen av intensjonelle aktører ble synliggjort 11. september 2001. En infrastruktur er analysert bestående av komponenter (mål, targets) i parallell, serie, koblet (interlinked), avhengige (interdependent), og uavhengige. Forsvarer av infrastrukturen, og multiple angripere, tilpasser seg hverandre ved å velge optimale defensive og offensive investeringer for hver komponent. Forsvarer ønsker funksjonalitet. Angriper ønsker dysfunksjonalitet. Infrastrukturens funksjonalitet avhenger av den relative investering i forsvar versus angrep for hver komponent, samt hvorledes komponentene er koblet sammen. Velkommen til foredraget.

Conventional operations research, risk analysis, reliability theory, and probability theory are limited by assuming play against static, fixed and immutable factors which are exogenously given. Population explosion, increasing complexity, and especially the terror threat prominent after the September 11, 2001 attack reveal that play occurs against adaptable, strategic, optimizing, dynamic agents with known or unknown preferences and beliefs that may or may not coincide with our own. The lecture starts with the simplest games; prisoner's dilemma, battle of the sexes, chicken game, coordination game. There are three requirements for a game-theoretic analysis: First, at least two players. Second, at least one player has a strategy set of at least two strategies. Third, the payoff to each player depends on the combinations of strategies chosen by all players. Game theory received the Nobel prize in economics in 1994 (John Harsanvi, John Nash, Reinhard Selten) and 2005 (Robert J. Aumann, Thomas C. Schelling). Threats against infrastructures emerge from nature, technology, and humans. No targets and no methods of operation are out of bounds. Strategic attackers go for targets with economic, human, and symbolic value. The strategic decisions for the defender (attackers) are how much to allocate to defense (attack), how to allocate investments across targets, and what kinds of defense (attack) are suitable. Operations research and reliability theory have traditionally been used to solve the defender’s optimization problem. A typical focus has been on hardening targets. Some research applying game theory considers isolated targets. For multiple targets one strand of literature associates one defender with each target. Conflicts then arise in series, parallel, and summation systems over which player(s) prefer(s) to incur the cost of risk reduction. Individual strategies at the subsystem level generally conflict with collective desires at the system level. Another strand of literature lets one defender defend an entire system. The defender minimizes the success probability, and expected damage, respectively, of an attack.

The success probability depends on the resources expended by the defender to strengthen each target. The probability of an attack has in earlier research been assumed to be exogenously given. The lecture introduces a conceptually new way of thinking. One strategic defender and arbitrarily many fully strategic attackers are assumed. The external threat is neither static, fixed, nor immutable. An arbitrarily complex system or infrastructure is considered with targets that are in parallel, in series, interlinked, interdependent, and independent. The defender and attackers adapt to each other optimally choosing defensive and offensive investments for each target. The functionality or successful operation of each target depends on the relative investments in defense versus attack. The functionality of the system depends on how the targets are joined together. The defender seeks functionality of the system while the attacker seeks non-functionality.