PROTON

Modelling the processes leading
to organised crime and terrorist networks

A brief introduction to agent-based models and their use in project PROTON

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What is an ABM?

- An agent-based model (ABM) is a computer simulation that models relations among agents (e.g. individuals) and their behaviour, thus providing a simplified representation of the social reality

Why are ABMs useful?

- ABMs are increasingly used to simulate the impact of specific policy interventions
- AMBs offer many advantages:
    - They enable policy makers and others to conduct virtual randomized experiments to assess the impact of different policies before actual deployment
    - They are often more cost-efficient and provide results more quickly than field experiments or pilot experimentations
    - They enable policy makers and others to test policies without harming individuals' rights and freedoms since the simulations are completely virtual
    - They enable policy makers and others to test the long-term effect of specific policies, e.g. the impact over a few years.
- ABMs applied to social processes have some caveats:
    - Simulation of complex social processes is still in its early days and it inevitably requires simplification of reality.
    - Results should be used with caution and preferably in conjunction with other data and information (e.g. social and financial costs of the policies, political, social and ethical assessment of the policies)
    - Simulations should be considered additional tools for policy makers in addition to other strategies such as experiments and evaluations
- The development and use of ABMs include a few requirements:
    - Proper simulation design and validation require specific expertise in the field of study (e.g. organised crime and terrorism) and in ABM design.
    - Simulations are just as good as the input data, i.e. simulations must be realistic to provide realistic results
    - The development of ABMs requires coding, statistical, and computational capacities

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The ABMs in Project PROTON

- The ABMs in Project PROTON comprise a set of different simulations (PROTON-S) modelling the factors leading individuals to join organised crime or terrorist networks
- The **PROTON-S simulations on organised crime** model how multiple social relations may influence individuals' involvement into organised crime: family, friendship, school, professional, and co-offending relations. The simulations also include relevant individual-level characteristics (age, sex, education, employment, and membership of an organised crime group). Based on their relations and individual traits, agents evolve through time. For example, agents grow up, study, marry, get/loose a job, have children, and commit crimes. The general assumptions of the simulations are that individual attributes and social relations drive the commission of crimes by the agents and that co-offending between two or more agents is driven both by individual attributes and by social proximity between the co-offenders. Furthermore, recruitment into organised crime occurs whenever a non-organised crime agent commits a crime with organised crime members. When organised crime agents look for suitable co-offenders, agents already embedded in organised crime social relations (agents who are close to OC members in their social networks) have a higher probability of being selected as co-offenders.
- The **PROTON-S simulations on terrorism** model the behaviour of heterogeneous agents whose routine activities take place in a neighbourhood of a representative European city. Agents are characterized by a set of socio-demographic characteristics, and opinion based risk and protective factors, namely: Integration/non-integration, institutional trust/legitimacy, and subjective deprivation. The simulation assumes that the agents' characteristics determine their routine activities, which in turn dictate their patterns of socialization. Socialization, as modelled by opinion-dynamics, consists of interactions between individuals. Over time, the cumulative effects of social interactions can lead to changes in these factors, affecting the overall risk of radicalization and recruitment to terrorism.
- The PROTON-S simulations were developed on the basis of systematic reviews on the factors leading to recruitment into organised crime and terrorist networks, innovative studies on organised crime, terrorism, and cybercrime, and laboratory experiments conducted during the course of Project PROTON. Results of these studies are available on PROTON's website (https://www.projectproton.eu/).
- The hypotheses and assumptions underlying the PROTON-S simulations are presented below and discussed in detail in PROTON Deliverable 5.1.

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What type of policy interventions do PROTON-S simulations test?

PROTON-S simulations on organised crime test two different types of policy interventions

- The first type comprises preventive measures to reduce recruitment into organised crime. This intervention includes two policy interventions:
    - Prevention through a policy specifically targeting juveniles living in organised crime families. The policy will provide them with educational and welfare support and diminishing the influence of organised crime relatives (by removing the connection with a father convicted for OC offences and OC-involved relatives). In addition to the general assumptions mentioned above, the intervention assumes that the public authorities know who are the OC members and that some wives of OC members may be willing to separate from the fathers to prevent their children involvement into a criminal culture.
    - Prevention through a policy targeting minors "at risk" in the general population. The policy will provide them educational and welfare support through the promotion of positive social relations with non-delinquent peers and adults. In addition to the general assumptions mentioned above, the intervention assumes that the public authorities can identify children at risk (e.g. by violent or aggressive behaviour reported by teachers) and that the children can be enrolled in the intervention. It also assumes that the intervention improves the educational attainment of the enrolled students.
- The second type of intervention comprises law enforcement disruption strategies and their impact on the recruitment into organised crime. It includes two policy interventions:
    - Disruption by targeting the leaders of organised crime networks. While keeping constant the overall arrest rates in the simulations, organised crime members will be targeted with a higher probability, depending on their positioning in the relational networks. In addition to the general assumptions mentioned above, the intervention assumes that the law enforcement agencies can identify the social relations of OC members and select the members with more prominent social connections.
    - Disruption by targeting individuals possessing specific skills necessary for the commission of complex crimes (also called facilitators). While keeping constant the overall arrest rates in the simulations, facilitators will have a higher risk of arrest whenever they commit a crime. In addition to the general assumptions mentioned above, the intervention assumes that the law enforcement agencies have identified potential facilitators of the commission of complex


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crimes (e.g. based on previous experiences, it is known that specific workers or skills are necessary for committing complex crimes).

PROTON-S simulations on terrorism tests two different types of policy interventions.

- The first type of policy intervention seeks to change the level of unemployment among high risk agents. Beyond affecting agents' propensity (a static feature of their overall risk), changes in employment status alter routine activities. According to the theoretical model, changes in routine activities should have a direct impact on opportunities for recruitment and secondary effects on socialization, and thereby, through opinion-dynamics, on risk and protective factors. It consists of the following:
    - Reduction of risk through a policy that specifically targets to change the propensity, risk, routine activities, and socialization opportunities of already high-risk individuals through offering incentives to employers and would-be employees. The intervention assumes that government agencies are able to identify a population of high-risk individuals who are in need of employment. It assumes that employed individuals have less time, and are less likely to come into contact with radicalizing influences and recruiters.
- The second type of policy intervention involves the deployment of two different types of "special agents" in the modelled environment, namely community workers, and community-police officers. It consists of the following:
    - Reduction of risk by introducing more community workers to operate at community centres, promoting trust/legitimacy, integration/connectedness, and improving subjective feelings of deprivation. The intervention assumes that community workers have positive values which will help to prevent radicalization, but that the number of such community workers is conventionally too small to have major impact on the community. Having more community workers in each Center will increase the likelihood that individuals in the community will have contact with them. As a result of these increased contacts, community workers will be more likely to affect agents' opinion-based protective factors, thereby reducing radicalization and the risk of recruitment.
    - Reduction of risk by training more police officers in community policing is also expected to act as a preventive factor. Our model assumes that police officers trained in this way will have more positive relationships with community members, and will reduce their sense of alienation from the larger community. In the base model, police officers have a neutral or negative effect on key values that affect radicalization. The intervention assumes that having more specially trained community police officers increases the likelihood of positive

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interactions, and decreases the likelihood of negative interactions. As a result of these increased opportunities, community police officers will be more likely to affect agents' opinion-based protective factors, thereby reducing radicalization and the risk of recruitment.

How the results of PROTON-S can be accessible to the wider public?

- A selection of the main results of the simulations are available on PROTON Wizard, a web-based interface accessible from PROTON website (https://www.projectproton.eu/)
- The PROTON Wizard stores and makes freely accessible online to any interested user some of the results of the complex simulations of PROTON-S
- The PROTON Wizard allows users to test different environments and policy interventions. At present, PROTON Wizard presents the results of the above summarised scenarios.

What is the use and advantage of PROTON Wizard?

- PROTON Wizard grants users the ability to visualise the results of the simulations through a few simple steps. Through a guided procedure the user will select the main options and will immediately access the results.
- Users can select multiple possible scenarios and policy interventions, and results are immediately retrieved from a set of pre-calculated simulations, instead of requiring hundreds of hours of computation
- The PROTON Wizard is user-friendly and requires no computational or statistical skills. PROTON provides a webinar to introduce the use of PROTON Wizard and a user guide is available on the Wizard page on PROTON website.

How can PROTON simulation settings be modified in the PROTON Wizard?

The **PROTON Wizard on organised crime** allows policy makers and others to choose the following options:

- **Select between two possible environments**: a society resembling a Southern European city and one simulating a Northern European city

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- For each environment, **select among four possible policy interventions** (presented above)
- For each combination of environment and policy intervention, users are able to **choose low/medium/high levels of:**
    - Number of organised crime members
    - Crime Rate, including unreported crime
    - Unemployment Rate
    - Law Enforcement Intervention Rate (criminal convictions resulting in a prison sentence for 10,000 inhabitants)
    - Punishment Length (duration of prison sentences)
- The medium level of each options will be based on empirical data from the Southern or Northern European city. Instructions and mouse-over popup will provide indications on the empirical values to guide the user in the choice of the preferred combination

The **PROTON Wizard on terrorism** allows policy makers and others to choose the following options:

- **Tailor the environment:** Adjust socio-demographic characteristics to tailor the environment to most closely match the European city of interest:
    - Gender ratio
    - Employment rate
    - Criminal history rate
- For each tailored environment, **select among three different policy scenarios** (described above)
- For each combination of environment and policy scenario, users are able to **choose from different levels of policy implementation:**
    - Number of community workers per community center
    - Proportion of community-policing officers on police force
    - Percentage change in employment of high-risk agents

How can PROTON simulations be adapted to other contexts/scenarios?

In addition to the options already available in the PROTON Wizard, further development and expansion of PROTON-S simulations and of the Wizard will be possible

- **The PROTON-S simulations codes are open access and freely available**, allowing any researchers, policy maker and interested stakeholder to download and modify the simulations (*note: this is part of Deliverable 5.1 an hyperlink will connect to the code*)

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- **Interested stakeholders may modify additional settings through the use of NetLogo**, one of the most popular freeware software for agent-base modelling (available on http://ccl.northwestern.edu/netlogo/). Working on NetLogo, however, requires some internal expertise in agent-based modelling and coding. Interested stakeholder can find details on PROTON Technical Manual or can contact the consortium for further advice (*part of PROTON Deliverable 5.1*).
- **Stakeholders interested in adapting PROTON-S simulations to specific social and economic environments may modify the input data of the simulations**. The input data of PROTON-S are a set of statistics on socio-economic variables, crime variables and other data. This procedure will require some data collection and social statistics capacity. Stakeholders willing to input their own information to adapt the simulations to a specific social environment can modify the data as specified in the PROTON Technical Manual (*part of PROTON Deliverable 5.1*).
- **Stakeholders interested in further expansion of the PROTON-S simulations**, e.g. testing additional policies or including additional social dynamics, may contact the consortium to receive further advice and guidance. The interested stakeholders should consider that this activity will likely require additional financial resources to ensure the necessary agent-based modelling, coding, and computational capacity. The consortium will be happy to support and participate in future expansions. Please refer to PROTON Technical Manual (*part of PROTON Deliverable 5.1*)

Additional sources (will be delivered as part of deliverables of WP5)

PROTON Deliverable 5.1 Report on PROTON simulator
PROTON-S Technical Manual (CNR)
PROTON Wizard User Manual (ITTI)
PROTON Wizard Technical Manual (ITTI)

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