Open
COllaboration for
POlicy MOdelling

D5.1 SCENARIO, POLICY MODEL AND RULE-BASED AGENT DESIGN

Document Full Name	**D5-1_v1.docx**
Date	**31/01/2011**
Work Package	**5**
Lead Partner	**SMA**
Editors	Scott Moss, Ruth Meyer, Ulf Lotzmann, Marta Kacprzyk, Magda Roszczynska, Ciro Pizzo
Document status	**Final – v1.0**
Dissemination level	**PUBLIC**

Table of Contents

List of Figures

List of Tables

Executive summary

As stated in the technical annex [OCOPOMO 2009], successful integration of policy modelling and scenario analysis for use by stakeholders and policy operators has not, as far as we know, previously been attempted. Certainly, the design, implementation and running of such models has informed scenario analysis and role playing games and therefore influenced stakeholders indirectly. To achieve the direct engagement of stakeholders with policy modelling and to use that engagement in the development of complementary scenarios amounts to significant progress beyond the state of the art not least by demonstrating a whole new approach to the use of models and scenarios in policy formation.

The work undertaken in work package 5, *Policy modelling and scenario process design,* has been driven by at this vision. The core objective of the OCOPOMO scenario and modelling process devised in WP 5 is to generate complementary informal, narrative scenarios and formal, model-generated scenarios. The central design feature of this process is a stakeholder-accessible formalisation of the narrative scenarios, called a *consistent conceptual design* (CCD). It comprises an ontology defining the relevant entities (actors, social entities, physical objects, abstract concepts) and their relationships, which in turn informs the specification of agent types, fact bases and rule bases in the formal model.

To be able to investigate and assess coherence between each of the phases of the scenario-modelling process, elements of the CCD are linked back to the base evidence in text format. Equally, the CCD elements are linked to the rules and facts of the model they inform, which in turn are linked to the model output. These links result in a clear *audit trail* from evidence, to the CCD to the simulation model and to the model output.

The collaborative scenario development process together with the rule-based design of agents representing individual actors in the chosen type of policy models allow for the desired integration of narrative scenario analysis with formal policy modelling in order to produce policy analyses with the precision and clarity of formal models and also the rich contextual and imaginative content of verbal narratives.

This deliverable documents in detail the work undertaken in WP 5, namely (a) the agent-based policy models, (b) the rule-based agent design, (c) the collaborative scenario development process, and (d) a refined requirements list for tool support in scenario-building and policy modelling.

With work packages 1 [Bicking et al. 2010], 2 [Mach et al. 2010] and 5 [this deliverable] completed, the first, conceptual phase of the OCOPOMO project has been successfully brought to an end, which provides a sound basis for the following implementation phase. The work reported on in this deliverable will feed directly into both work package 6, implementing the procedures and conceptual pilot models devised, and work package 3, continuing the development of the declarative rule-based agent modelling software as a component of the ICT tool box.

1 Introduction

This deliverable presents the results of activities performed within work package 5: *Policy modelling and scenario process design*. The overall goals of this work package – as stated in the technical annex of the OCOPOMO grant agreement [OCOPOMO 2009] – have been first to define the integrated policy modelling and scenario process in terms of the approach to be chosen. Based on this procedural way forward, both the process development for agent based policy modelling and the process design for collaborative scenario development have been carried out. This has led to several refined requirements for specific components of the ICT tool box (cf. Deliverable 2.1, [Mach et al. 2010]).

The structure of the deliverable is as follows:

Chapter 2 outlines the OCOPOMO approach to policy modelling, namely agent-based simulation models, which are grounded in evidence and involve stakeholders as emancipated partners in the model building process.

Chapter 2.1 discusses the collaborative scenario development process, which lies at the core of the OCOPOMO approach. The central design feature is a consistent conceptual description (CCD), which links the initial scenario to the formal agent-based models. An explicit audit trail keeps track of which elements of the model, e.g. a single rule, are based on which elements of the descriptive input.

Chapter 4 details the design of the software agents representing the actors in the policy models. Individual behaviour, like decision making and interaction with other agents, is captured in logic-like rules. This offers the advantage of both being close to the natural language description of the stakeholders and maintaining the clarity and precision of formal models.

The declarative rule-based agent modelling software (DRAMS), described in chapter 2.1, enables the development of exactly the type of models required by the OCOPOMO approach.

The prototype models of the case studies in Kosice and Campania and the initial version of the macroeconomic model demonstrate both the feasibility and usefulness of this process, even though its technical support is still in its infancy (see chapter 5). We have now added a third case study concerned with housing policy in London. This is a particularly useful case study in that there are a large number of stakeholders including the Greater London Authority and 33 borough councils as well as central government agencies, housing associations and NGOs. Because of their different roles and responsibilities, the value of the OCOPOMO process will be of immediate and considerable value. This change from the DoW will involve some additional resources contributed by partners Volterra and SMA and some minor reallocation of existing resources by SMA from travel to staffing.

The deliverable ends with a list of refined requirements for the ICT tool box (chapter 6) and a short conclusion (chapter 7). The appendix provides background material for both case studies used in the development of the respective prototype models.

2 The agent-based policy models

Agent-based policy models specified for OCOPOMO differ from older approaches to policy modelling in two important ways.

The first is that the models are strictly evidence-based and built around the descriptions, expectations and beliefs of stakeholders in the policy process. The models are not driven by prior theories except to the extent that the theories have been developed in close connection with evidence and well validated independently of the models developed for the policy analysis.

The second important difference is that the nature of the models and their development implies a different relationship between the modellers and the clients – in this case the stakeholders – in the policy development, design and implementation process. The modelling process involves stakeholder participation so that the stakeholders and modellers are in effect partners. Traditionally, the policy makers are clients and modellers are contractors who provide the model and its outputs as a product. Another way of thinking about this difference is that the modeller in the OCOPOMO process is providing a service documented by and on the basis of the evolving model whereas, traditionally, the modeller provides a product. (Obviously, the difference is one of emphasis – the OCOPOMO modeller is more service-oriented and the conventional and traditional modeller is more product-oriented.)

In the context of a participatory stakeholder process, the model cannot be free-standing. It has value only as an element in the participatory process. Indeed, this is the source of the role of the modeller as a service rather than a product provider. The objective of the modeller is to implement a model the design of which is constrained by evidence obtained from stakeholders and other domain experts and to make the design and behaviour of the model transparent to the stakeholders as end-users.

Designing the model to represent stakeholder-actors as explicit software entities and to capture interactions among stakeholders as interactions among the agents representing them is intended to facilitate validation of the model by the end-users and also to enable them to explore different behavioural representations explicitly. In a sense, the use of agents minimises the degree of abstraction of the modelled representations of actual or prospective social processes whilst, at the same time, maintaining the precision and rigour of formal methods.

2.1 Declarative rule-based agent modelling software

An extensive literature search failed to identify any suitable software for the declarative modelling requirements of OCOPOMO. Existing declarative, rulebased development environments such as JESS are based on the rete algorithm that optimises the execution of rules over a given fact base. This is suitable for expert systems (JESS = Java Expert System Shell) where facts change infrequently. In social simulation, however, the facts on the fact base are always changing. With the rete algorithm, every such change triggers a compilation of the rulebase. This is time- and resource-consuming to the point that, with reasonably complicated models, the use of such software becomes untenable.

Instead, we have relied on an algorithm that is suitable for optimising rule execution in an environment of changing facts. This is based on the notion of rule and data dependency. Dependencies are calculated for each rule by noting which facts must be present for it to be fired and then which other rules can produce such facts. Then, the rule engine need only consider at any time which rules have already fired and, therefore, which rules could now be fired. Once all of those have been fired or the LHSs of which have been found not to be satisfied, the rule engine need only consider the relatively small number of rules (if any) that have satisfied dependencies. The point at each such juncture is that the firing of rules determines changes in the fact base and those changes determine and limit the set of rules that could possibly be fired.

DRAMS, the Declarative Rule-based Agent Modelling System, provides the necessary rule engine functionality to enable modellers in the OCOPOMO project to develop such declarative agent-based simulation models as discussed in the previous chapter.

Each agent has a fact base, containing its knowledge about the state of the world in the form of facts, and a rule base, specifying its behaviour in the form of rules. Rules are agent type-specific, i.e. all agent instances of the same type share the same rule base In addition, there is a global fact base, which is shared among all agents and contains publicly known "world facts", e.g. the current simulation time, the list of all agents, and model-specific environment data.

Communication between agents can be achieved by either writing to and reading from the shared global fact base (analogous to a blackboard system) or by letting agents access each other's local fact bases (direct exchange of messages).

To achieve the required speed of execution, rule bases are compiled on dependency digraphs where each link indicates that conditions on the LHS of the rule represented by the to-node are satisfied if the RHS of the rule represented by the from-node has been executed.

2.1.1 Implementation

DRAMS realises a distributed rule production system: each agent has its own rule engine, which hosts the agent's fact and rule bases and controls the inference process. A central rule engine manager keeps track of all rule engines and hosts the shared global fact base. The rule engine manager also compiles the overall data dependency graph, used to determine which rules can fire and in what order.

The data-driven algorithm for this is implemented in the rule scheduler. At each point in a simulation run, all rules for which new facts are available are scheduled for evaluation. Successful evaluation of a rule's LHS results in the rule being entered into a conflict set of possible rules. All possible rules fire, in an order resolved by the rule scheduler. Firing a rule executes its RHS, which may include assertion of new facts or retraction of existing facts, thus triggering the rule scheduler again.

Simulation time advances only after no more rules can be scheduled for evaluation. The rule scheduler allows two modes for time advance, time-driven ("active time") and event-driven ("passive time"). In the first mode (see Figure

1), time advances in regular intervals, whereas in the second mode the simulation time is set to the next closest event time (see Figure 1: Activity diagram for scheduler in passive time mode).

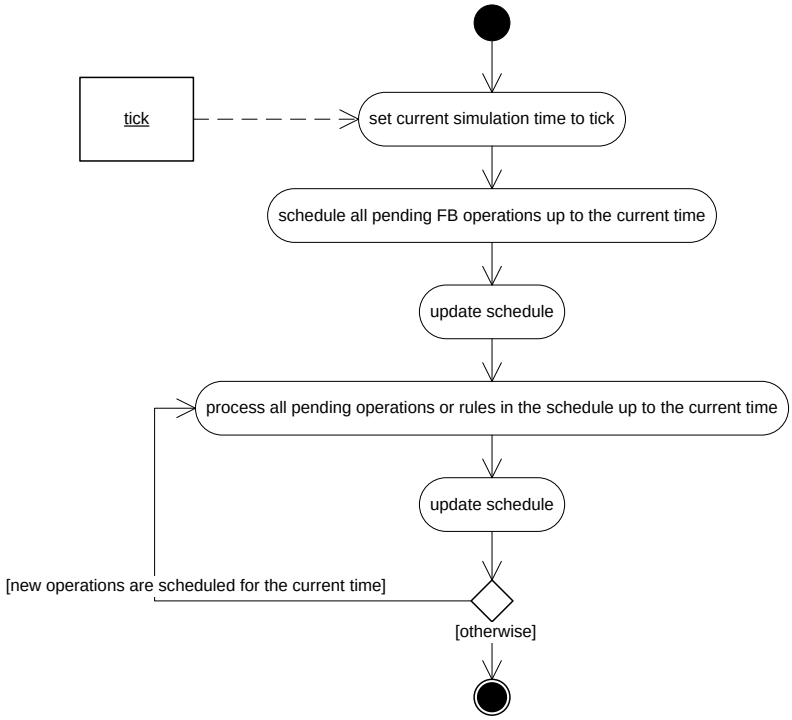


Figure 1: Activity diagram for scheduler in active time mode.

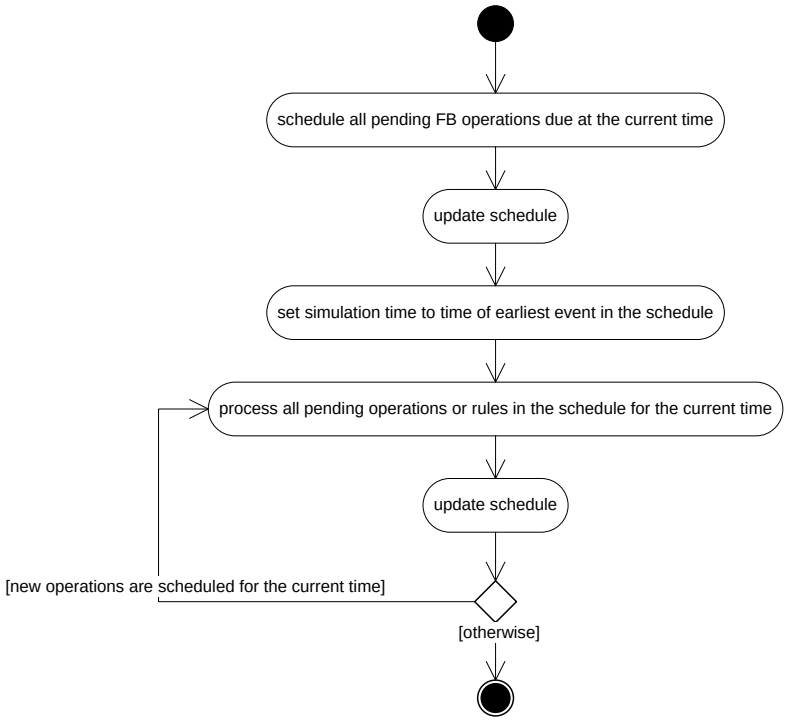


Figure 1: Activity diagram for scheduler in passive time mode.

Figure 2 shows an overview of the relevant DRAMS classes, including the interface to an existing agent-based simulation toolkit (Repast). At the moment,

DRAMS provides abstract *Agent* and *Model* classes to facilitate the integration with Repast. A modeller using DRAMS and Repast only needs to subclass these abstract classes to gain access to the declarative features of DRAMS within the simulation environment of Repast.

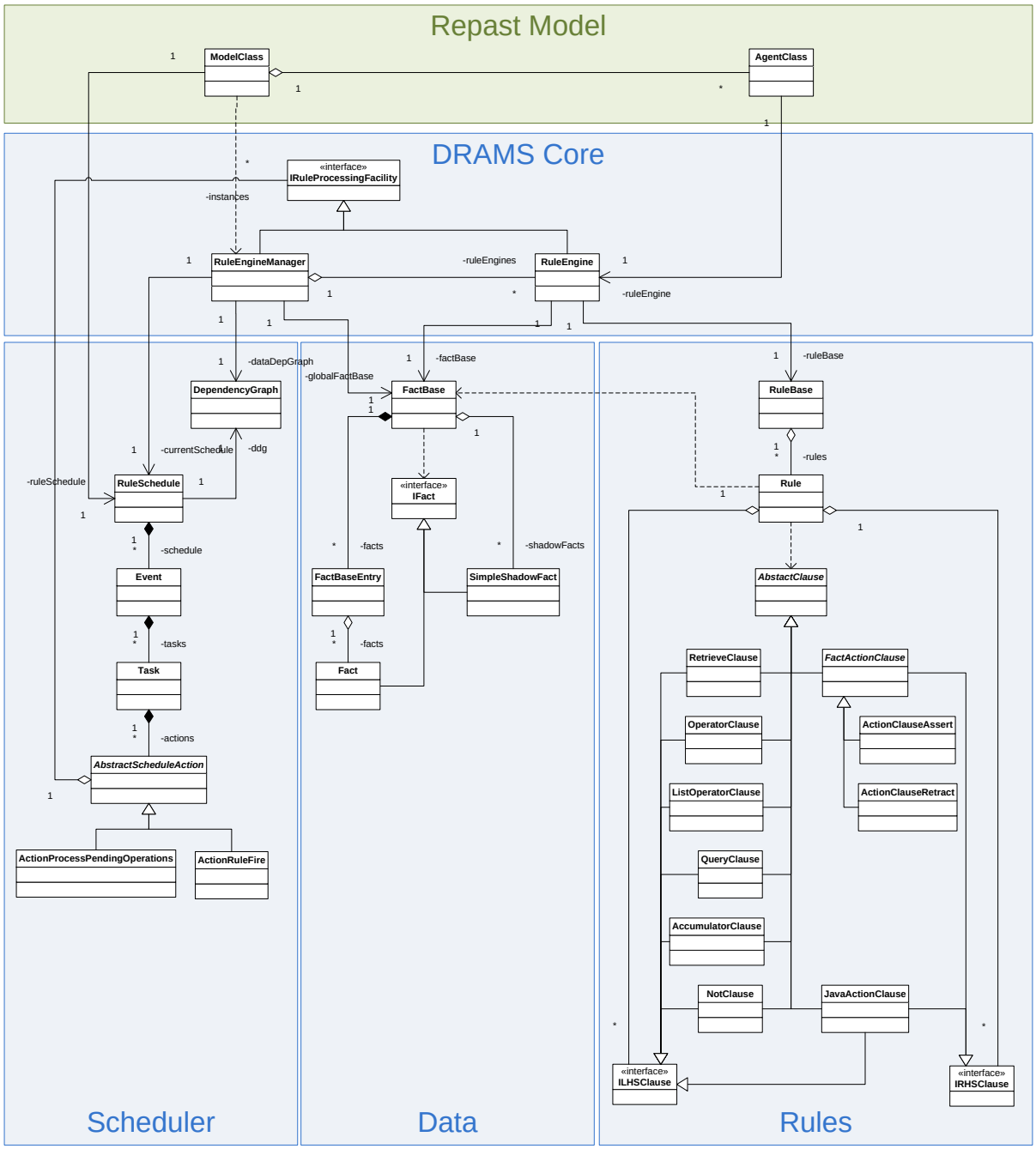


Figure 2: Simplified class diagram of DRAMS and its integration with Repast models.

2.1.2 User Interface

The current provisional user interface (see Figure 3) is designated to support the development of model prototypes and debugging of the DRAMS software. A SWING based window can provide several different views: the overall data dependency graph (tab marked DDG in the upper right hand side of Figure 3),

the overall rule dependency graph (RDG), separate rule dependency graphs for each agent type (tabs "Company" and "Customer") and a trace of the rule schedule while running a simulation (tab "Schedule").

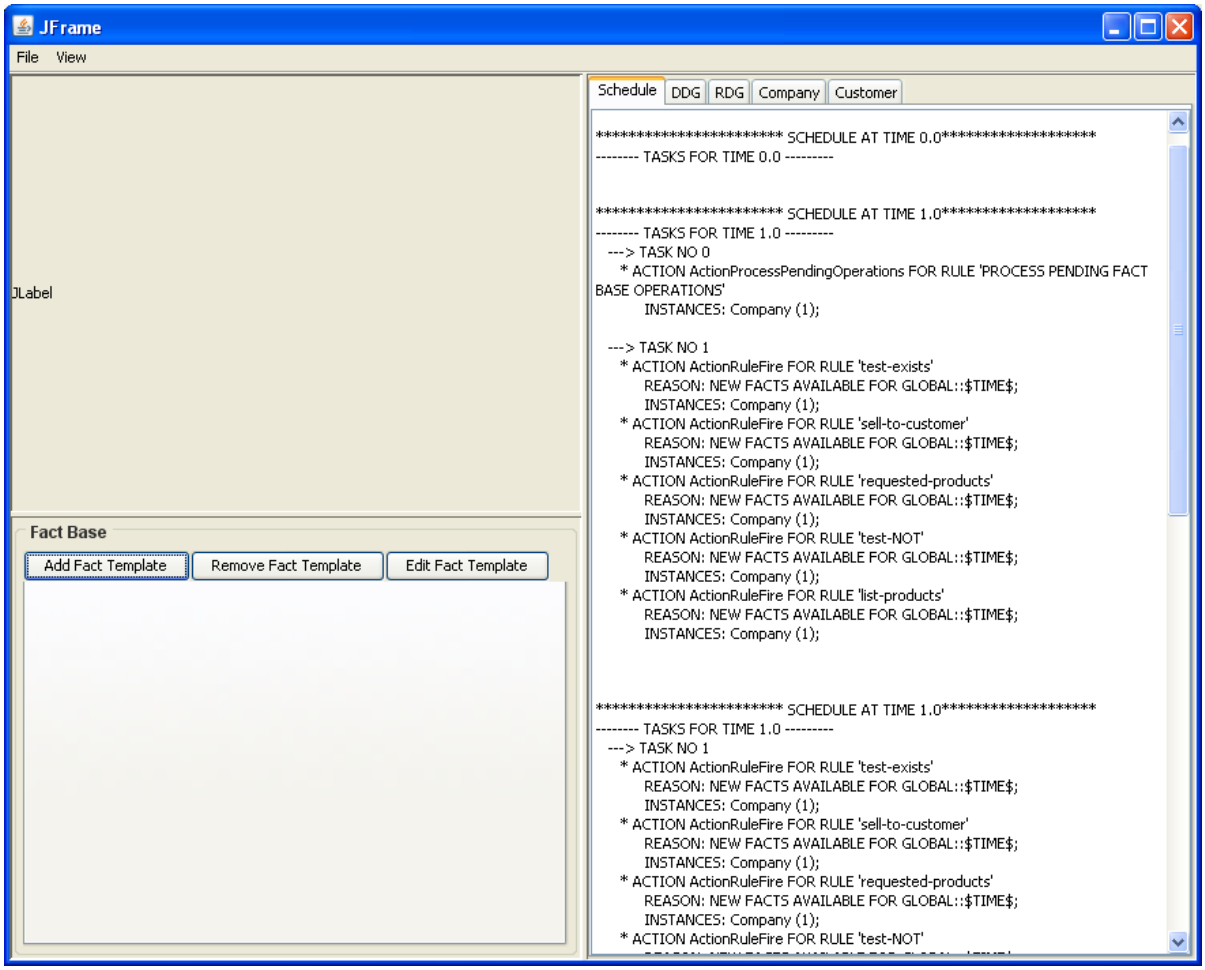


Figure 3: DRAMS graphical user interface showing the trace of the rule schedule.

The overall *data dependency graph* shows the dependencies between facts and rules (see Figure 4). Facts are displayed as ellipses, containing the fact name prefaced with the fact base owner (agent type or GLOBAL). "Green" facts are available at model initialisation time, whereas "red" facts have to be generated during simulation runs. Rules are displayed as blue boxes, containing the rule name prefaced with the associated agent type (rule base owner).

Blue arcs connect a rule with all facts that are required on the LHS of the rule. A solid arc indicates that a fact is used in a retrieve clause, while a dashed arc indicates the involvement of a query clause. Facts that are asserted by the RHS of a rule are linked by solid green arcs. The number in square brackets represents the deferment time for this assertion (default: 0.0). Solid red arcs denote that the rule retracts the linked fact from its fact base.

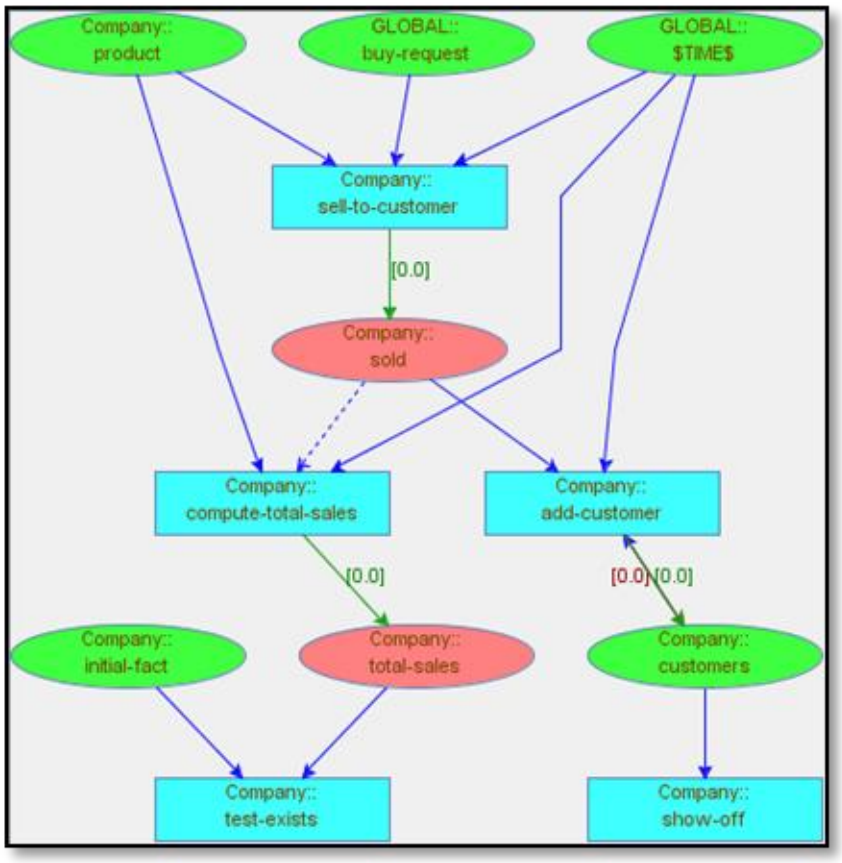


Figure 4: Example of a data dependency graph

From the data dependency graph DRAMS automatically derives the overall *rule dependency graph*. A rule A depends in its execution on another rule B if it requires a fact F as input, i.e. on its LHS, that rule B produces as its output, i.e. on its RHS. In the example in Figure 3 the rule "compute-total-sales" of agent type Company depends on the rule "sell-to-customer" because it needs facts of type "sold", which are asserted by "sell-to-customer" (see the DDG in Figure 4).

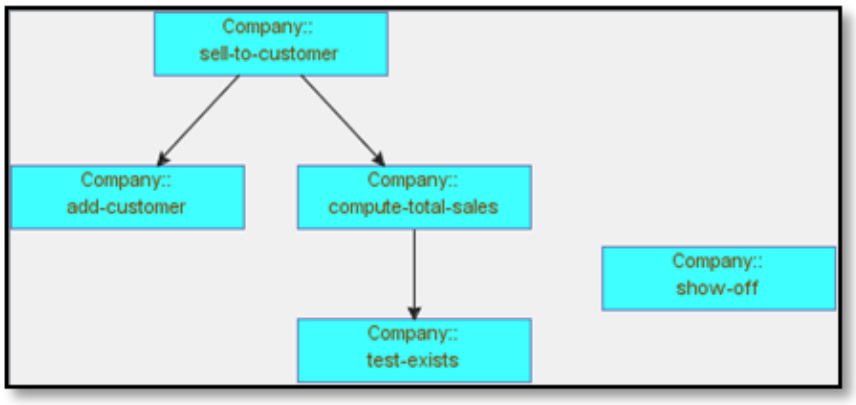


Figure 5: Example of a rule dependency graph

3 The collaborative scenario development process

The OCOPOMO toolkit enables stakeholders and other non-specialist users of the toolkit to define policy issues, goals and instruments and to specify detailed characteristics of an agent-based policy model. They will also be able to determine how the outputs from such models were produced by the ways in which they specified the model characteristics. Despite their control over the model specification and output analysis, no end user of the toolkit need ever have to engage with the formal policy model itself.

The central design feature is a consistent, conceptual description (hereinafter, CCD) of the policy environment. The CCD has three elements:

1. A specification of agent types representing classes of stakeholder and possibly instances of one or more stakeholder classes represented by a named software agent.
2. An ontology comprised by nodes representing non-cognitive entities such as groupings or institutions or artefacts as well as agent types. Relationships amongst these entities are expressed by links which are labelled by the nature of the relationship. Such relationships my be in the nature of ownership or influence or is-a or kinship (among agents) or purchase or sale or perform or any quality or process that links the entities. Some relationships entail reciprocation such as in a transaction where I buy and you sell some good or service.
3. A description of relevant social processes where the description takes the form of *if-then* rules specifying the conditions in which particular actions will be undertaken. Since some actions create the conditions in which other actions can or would be taken, some of these *if-then* rules will depend on others. Consequently, the descriptions of these rules will be linked in a dependency graph.

These three elements specify the major features of the corresponding policy model. The agent specification determines the agent classes and in some cases instances of those classes where each agent is defined on an ability to access facts from databases (which we call fact bases in OCOPOMO) and a rule engine that enables the agent to process the facts selected from fact bases and, using rules, to produce new facts that are inserted into appropriate fact bases. The ontology determines the kinds of facts – represented by fact templates in the models – that are relevant and should be captured in the model as well as some specific facts that should be held in fact bases at the start of each run of the model. The rules and rule dependency graphs are the skeleton of rule bases to be implemented for each class of agent.

These elements are explored in detail in this section.

3.1 Integrating stakeholder- and model-generated scenarios

The OCOPOMO process integrates modelling into policy analysis, formation and implementation by stakeholders. Modelling is itself a specialised skill that cannot be left to stakeholders whose skills and expertise lie in other areas.

Consequently, the integration of modelling into a participatory stakeholder-led process will continue to require the services of modelling experts.

Two key questions are (i) how we can ensure that the modellers' implementations are constrained by stakeholders' perceptions, expectations and expertise, and (ii) how the model outputs can be designed effectively to inform the stakeholders' understandings and intentions. The expression of the understanding, intentions, objectives, perceptions, expectations and expertise of stakeholders will be explored by having them produce scenarios of the outcomes from various policy initiatives suggested by the stakeholders and developed by their generation of scenarios (step 1). These scenarios must then be restated in a more formal way (step 2) to guide the stakeholders in identifying gaps in their reasoning, and to make their assumptions more precise. This stakeholder-accessible formalisation is a *conceptually consistent design* (CCD; step 3). It comprises an ontology defining the relevant entities (actors, social entities, physical objects, abstract concepts) and their relationships, which in turn informs the specification of agent types, fact bases and rule bases. The ontology is a means to produce a clear conceptual model of the case study as a whole, at a level of detail sufficient to develop the necessary model structures while being open to future refinements.

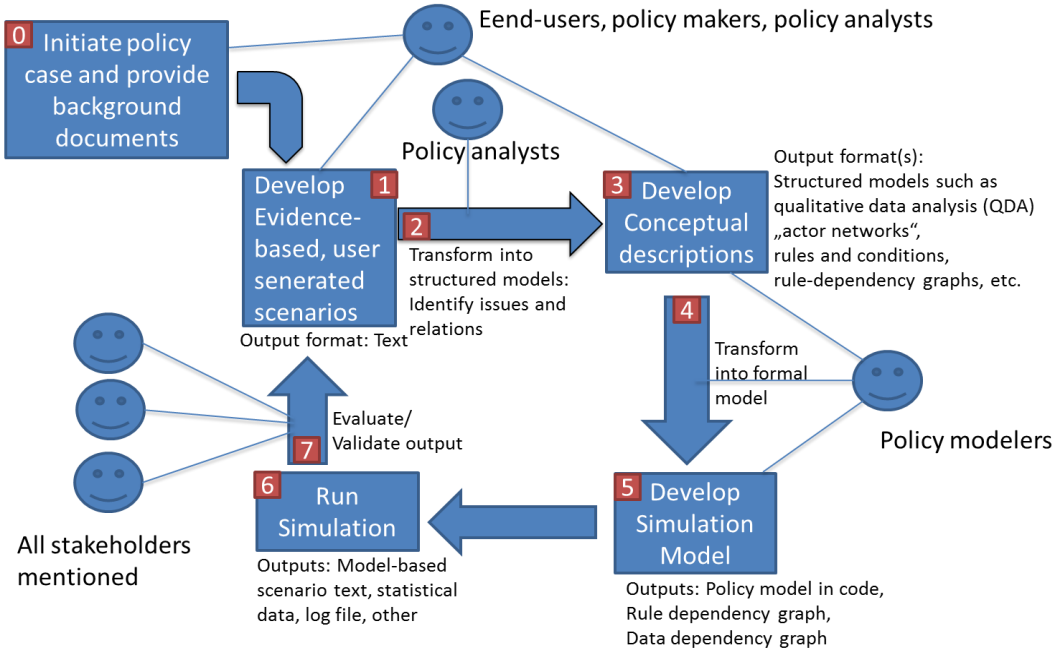


Figure 6: The OCOPOMO process

In order for the CCD to be comprehensible to stakeholders, it is to be presented as visualisations. For the ontology, this can for example be a simplified UML class diagram with boxes representing the entities (classes) and two types of arrows representing the relationships (hierarchies, dependencies). In order for it to constrain the models, the visualisations have to be tagged with information used to create structures for the models (step 4 and 5). The models then have to produce outputs (step 6) that can be used to create visualisations to be compared with the CCD visualisations (step 7).

The CCD is the link between the evidence and the model. The evidential core will be the scenarios generated by stakeholders, initially in scenario-generation sessions but later online using the OCOPOMO toolkit described in Deliverable 2.1. In addition, it will be possible to incorporate documents into the system and these, too, will inform the CCD.

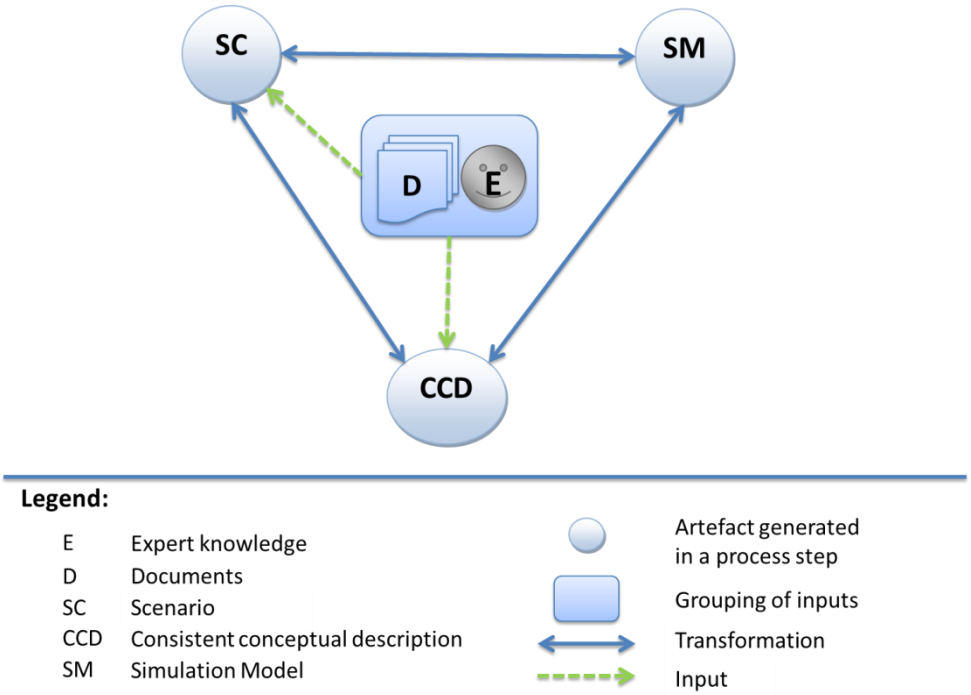


Figure 7: Main artefacts and their dependencies

A core question is clearly how we will ensure conceptual consistency. An existing option is the use of ontology software such as Protégé [PROTÉGÉ 2010] using the web ontology language, Owl, and the ontology reasoning engine, Racer. However, whilst ontology software can excel at producing formal consistency of entities and the relations amongst those entities, the conceptual basis of the ontology renders it unsuitable for capturing temporal processes including the processes described by scenarios. The objective of formal consistency in the descriptions informing the models is, nonetheless, one that is accepted as being strongly desirable for the OCOPOMO toolkit.

Another means of ensuring formal consistency and soundness in the CCD is to implement the corresponding model or models to be constrained by the CCD so that if the models do not crash or fall into infinite loops, they and therefore the CCD must be sound, consistent and decidable. The difference between the OCOPOMO toolkit and (say) Protégé, is that using software such as Protégé ensures formal consistency in the CCD before modelling begins. With the OCOPOMO toolkit, there must be a draft CCD which is used in the implementation of the model but may not initially be known to be formally correct. If the model runs successfully, there is reason to believe that the CCD is formally consistent. If it does not run successfully and is known to be constrained by the CCD, then there are grounds for investigating whether the CCD is in fact consistent.

3.2 The CCD and the audit trail

The position we have reached is that we require to investigate consistency between stakeholder- and model-generated scenarios and also between the CCD and the model. In both cases we are concerned with the coherence and consistency of the descriptions of process.

To be able to investigate and assess coherence between each of the phases of the scenario-modelling process, we require to be able to link elements of the CCD to the base evidence in text format and from the CCD to the rules and facts of the model, thence to the model output. These links will give us a clear audit trail from evidence, to the CCD to the simulation model and to the model output. The text output of the model describing its generated scenario must have links back to the rules and facts that produced each textual phrase. The rules and facts (or types of fact) must have links back to elements in the CCD. For this reason, the CCD itself needs to contain the structure of the rule bases and define the types of facts that are to be inserted into the model fact bases as well as the types of agents that will be implemented.

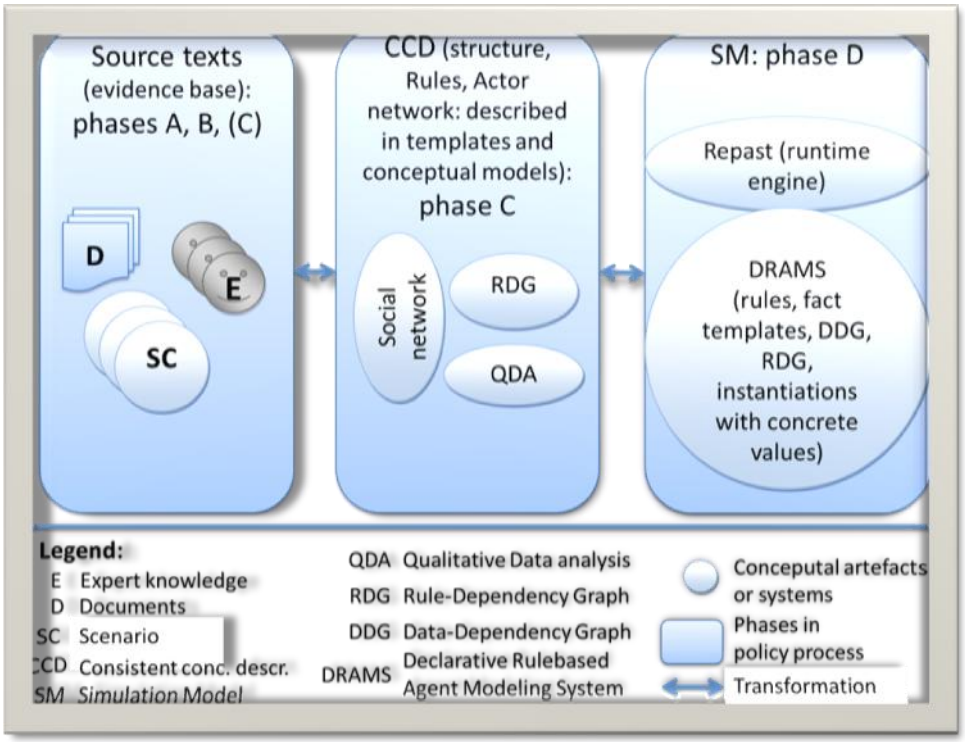


Figure 8: Overview of the different phases of the OCOPOMO policy process

Both for maintenance of an audit trail from evidence through CCD and model to model output and to constrain the model by the CCD, the CCD will be comprised by pseudo rules, templates for the facts available in the model and templates for the agents. The CCD will have much of the information contained in an ontology insofar as the agents are model entities and relations amongst agents will be represented by a social network diagram. In addition, by incorporating a pseudo-rulebase, the CCD will also specify elements of the social processes determining the effects of proposed policy instruments.

None of the elements of the audit trail of the CCD in particular are incompatible with ontology. The inclusion of ontology into the CCD to represent social and other, especially physical, relationships might well turn out to be effective.

3.3 Visualising the CCD

The presentation of the relationships amongst the raw data, the CCD, the model and the outputs must be sufficiently uncomplicated that stakeholders who are not *au fait* with the process will be able to understand its basic features and learning incrementally about its richer features. In the best of worlds, they will be able to design models even if they lack the experience or inclination to implement them. Certainly, they should be able to understand the elements and relationships captured by the model design.

The top level of the CCD visualisation will be a container of agent types. Each agent type is depicted as a container within the agent types container. Each type has an associated text-based description drawn from the raw data which itself is comprised of transcripts and text-based accounts of interviews with stakeholders and other domain experts and written accounts of scenarios generated by stakeholders as well as for example, world-wide-web links.

The agent types container exhibits the types that correspond to stakeholders described in the raw data. A coherent and integrated account of each of these stakeholder (and therefore agent) types is linked to the respective agent type labels. The top-level structure of each of these accounts will describe the actions available to the type of stakeholder represented by that agent type, the criteria they apply in assessing courses of action and sources of information, advice and role models, and the conditions they recognise and that condition the actions they will consider. The criteria for actions and social interactions are formalised as labels to be applied to agents and potential actions and mental models relating actions to abstract sets of conditions. The application of these criteria to objects and social entities will be captured as rules in the simulation models. For example, if someone repeatedly makes promises and then fulfils them, the subject of those promises will decide that that individual is “trustworthy” or “reliable” or both. Failure to fulfil promises will lead to the conclusion that an individual is “untrustworthy” and/or “unreliable” (unless reliably untrust-worthy). There will be rules to identify such behaviour and apply the appropriate label – an example of what we call *endorsements* to such agents. In general, these endorsements and the conditions in which they are applied will be determined in collaboration with the relevant stakeholders. These conditions and consequent endorsements are formalised as rules – specifically as endorsement rules. The collections of endorsements attaching to different agents or different actions will generally determine which agents influence one another and which actions are chosen when several are possible.

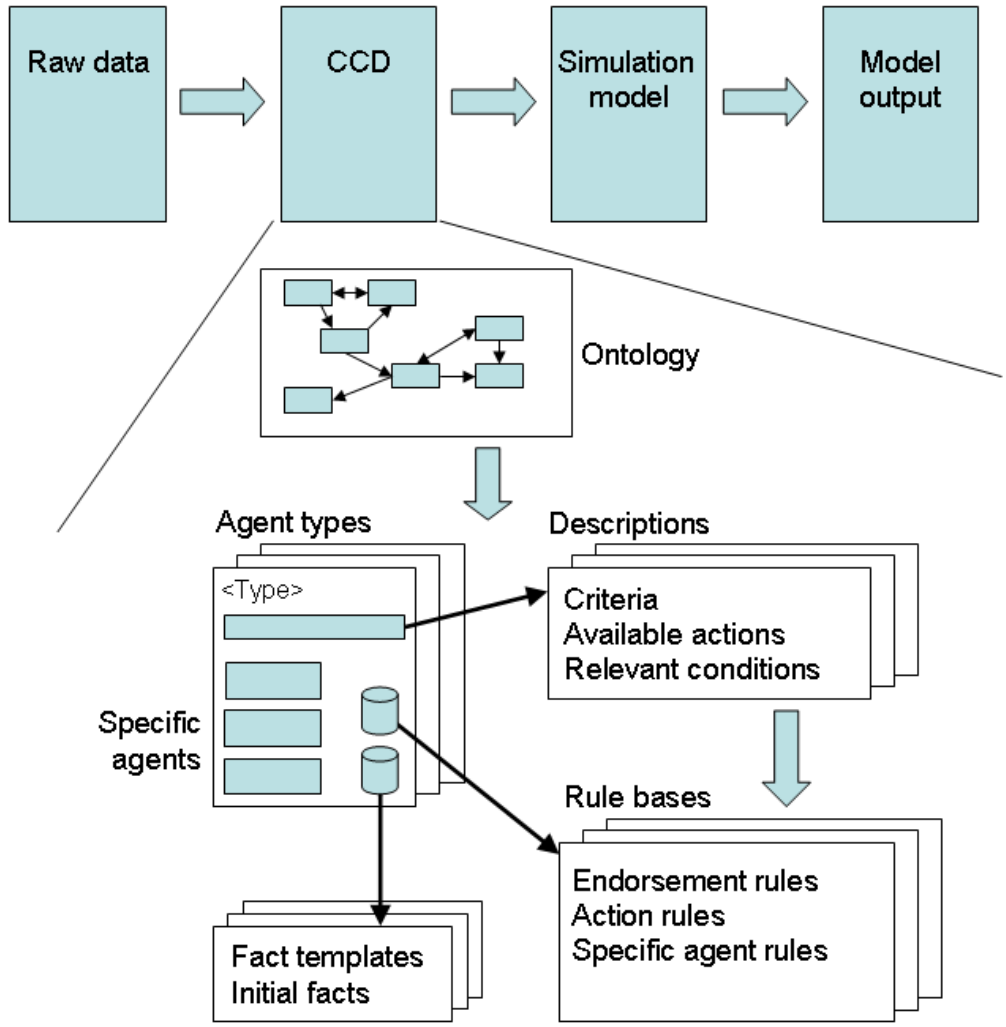


Figure 9: Conceptual design interface structure

Rules which produce actions by an agent – which we might call *action rules* – are also drawn from the raw data. Different conditions produce different actions. When alternative actions are possible in the same conditions, the best endorsed actions for those conditions will be chosen. There are many ways of determining which collections of endorsements are in some sense the best and these, too, can be captured by rules informed by the raw data.

For purposes of the audit trail, each endorsement and action and the conditions in which different actions might be considered have to be represented explicitly in the agent-type descriptions with links back to the raw data on which the specification of those actions, conditions and endorsements are based.

This material is then used to produce pseudo-rules – rule specifications that state the conditions in which actions might be taken. The collection of rules can (and should) be well structured. The top-level structure has two folders – one for endorsement rules and one for action rules. It is open to the users to create subfolders. If one type of agent endorses several types of agents (the same and different types) then if there are many endorsements and many rules it is likely to be useful to have one subfolder of the endorsement rules folder for each type

of agent or other object being endorsed. Alternatively, there may be different contexts in which a particular endorsement is attached to another agent in which case it might help to keep matters clear by having subfolders for each such endorsement. If the issues are even more complicated, then there could be subfolders for each agent type being endorsed and then subfolders of those subfolders for the main endorsements. Similarly, there might be different types of actions that could be taken in the same circumstances or many different circumstances in which an action might be taken. In either case, several levels of subfolders could help to keep the issues involved under control.

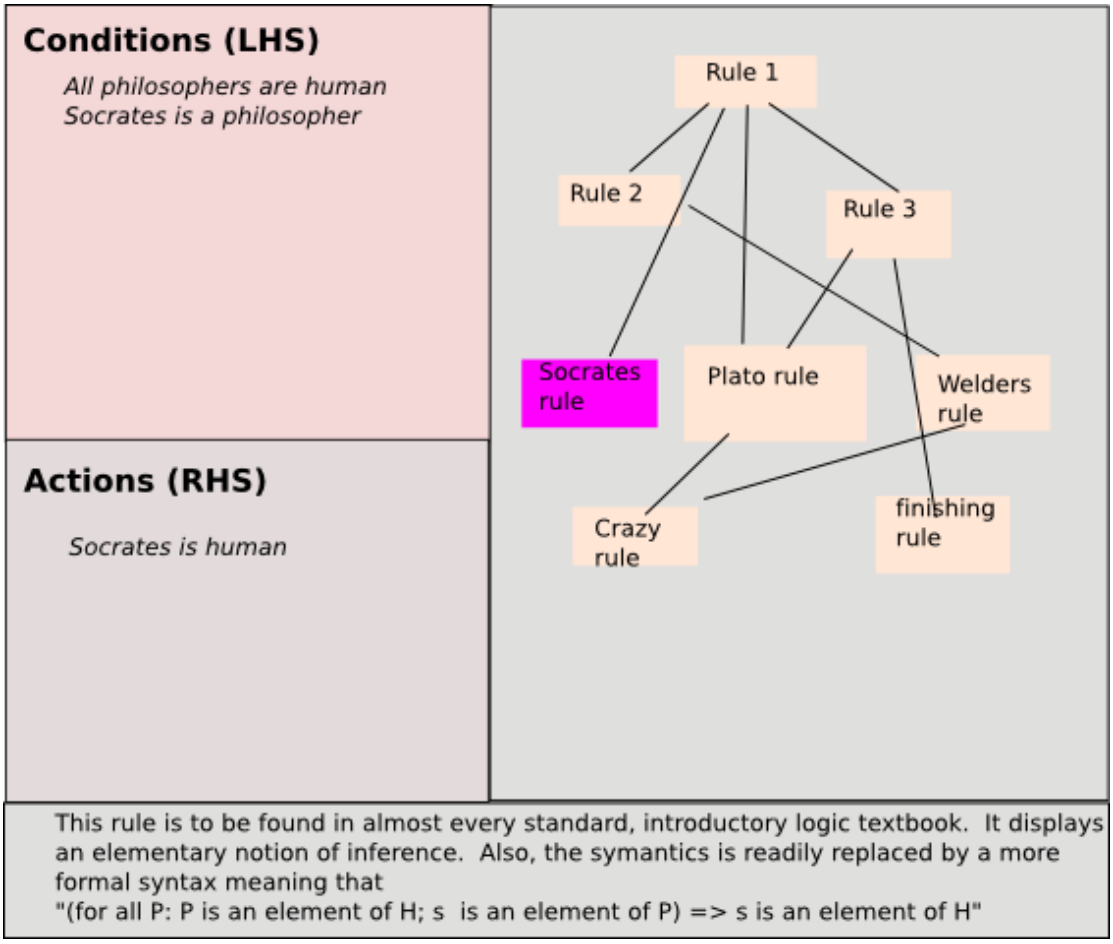


Figure 10: Rule-authoring window (mock-up)

For purposes of model validation, the authors of any rule base will be able to draw rule dependency graphs. For each agent type there will have to be a link (accessed from a pop-up menu) to a rule-authoring window. A mock-up of the rule-authoring window is depicted in Figure. A rule is defined with a rule name and the corresponding icon appears in the right hand pane of the window holding the rule dependency graph. The conditions and actions are written in the appropriate panes and a comment describing the provenance and context of the rule in the comment pane at the bottom of the window. Selecting a rule node in the dependency graph brings up the conditions, actions and comment panes for that rule.

If either of the conditions is drawn from raw data, a link should be created to the relevant text or URL. The proposition that Socrates could be human should be

linked to an element in the raw text and, if there is external evidence for the whole inference, that too should be linked from the rule.

Note that the style of the rule is close to that of predicate logic. This is appropriate for the DRAMS software developed for the project which itself enables us to work towards an explicit formal basis for the models. In such a declarative system, the "action" of the rule is an assertion of a new fact – in this case that Socrates is human. The asserted fact could also be a statement about the state of the world or a change in the state of the world. If it is important to some agent that Socrates is human and that induces some further inference changing the state of the world, then the rules constitute a framework for a process of change. And that is a key point—declarative modelling captures the emergence of process whereas imperative modelling imposes the process on the model. Since our purpose is to explore the processes that different policy alternatives set in train, it is clear that declarative modelling is the more appropriate.

3.4 Stakeholder- and model-generated scenarios

A core issue in the development of the OCOPOMO policy process is the initial elicitation of policy issues, instruments, targets, hopes expectations and perceptions. These are all features of the process of policy analysis that will be refined and tested by comparing stakeholder-generated scenarios with model-generated scenarios. There are, of course, many precedents for the generation of scenarios by stakeholders without any involvement of modellers or use of models. In general, however, such scenario development takes place within a framework provided by facilitators. Foresight processes in particular take as given spectra of social and/or environmental features that are assumed to prevail over the course of the scenario. The scenario process developed by the Intergovernmental Panel on Climate Change is based on families of scenarios and storylines. Each scenario is developed within the framework of a storyline. Experience shows that some such framework and guidance is necessary for stakeholders profitably to produce scenarios for any strategy or policy.

The raw data from which the OCOPOMO process starts is not structured in a way that would guide, constrain or stimulate the scenario-generation process for stakeholders. Structuring this data is naturally within the role specification of the facilitators and modellers (who may, of course, be the same persons). The structuring of this data takes place initially in the formulation of the CCD. At this stage, inconsistencies are likely to be identified and these can be resolved in discussion with stakeholders. It is possible that the inconsistencies result from conflicting interests and perceptions of different stakeholders (for example, polluters and environmentalists) in which case the inconsistencies indicate the need for different models.

The CCD phase of the OCOPOMO process produces well structured data about the nature of the environment and the behaviour of individuals and how they interact socially and with such elements of the state of the world as technology or climate. This is rather like the context specifications in a Foresight process but one which is much more highly elaborated. Perhaps it is too complicated and detailed for stakeholders to engage with. The model outputs constitute explicit

and precisely formulated scenarios, the individual features of which can be explored in depth using the OCOPOMO toolkit. This will make it possible for stakeholders to explore the model-generated scenarios to whatever depth they like. These scenarios therefore constitute a flexible framework to explore the issues associated with the relevant policies and can be used as a framework and starting point for the generation of different scenarios seen perhaps to be more realistic and also for the elaboration of the model-generated scenarios to capture the "softer" aspects of the policy processes that are not well represented by formal models.

4 The rule-based agent design

4.1 Purpose and characteristics of OCOPOMO agents

While there is no absolutely standard definition of an agent, all definitions and agent applications have three areas of functionality: perception, processing and effecting – sometimes called preceptors, processors and effectors, respectively. Another important feature of agents is that they are, in a specific sense, autonomous. By autonomy is meant that the agent is a self-contained computer program usually embedded in some larger software system. It is self-contained in the sense that the agent-as-program determines what it should perceive; it processes those perceptions and then produces an effect without relying on any other program code elsewhere in the system.

The key decision in agent design is the specification of the processor. The design of the processor should be determined by the purpose of the agent. In the early days of agent-based software engineering, Wooldridge and Jennings (1995) argued that agents should be as simple as possible with the least possible interaction among different autonomous agents. This design feature was intended to ensure that agents would be able deterministically to control, for example, such safety-critical systems as air traffic control systems and spacecraft controllers. Dense interaction among agents can lead to unpredictable, emergent consequences which are anathema to software engineers whose requirements analyses specify detailed criteria of program functionality.

For purposes of social simulation in general, the function of the agent is to capture individual (usually but not necessarily human) behaviour and the outcome of social processes resulting from the behaviour of collections of individuals. Just as in real societies, the social outcomes of individual behaviour and interaction among agents are not always predictable. Indeed, this very unpredictability is an essential aspect of real societies. In order to capture real social processes, therefore, OCOPOMO software agents are designed with the following characteristics:

1. Agents' behaviour is *metastable* in the sense that it changes only in response to significant social or other environmental pressures.
2. Agents interact with other (but not all other) agents.
3. Agents influence but do not imitate one another.
4. Exogenous, major (e.g. catastrophic) changes to the nature and the structure of the "society of agents" are not considered.

In physics, these characteristics are, respectively, that (1) entities are metastable, (2) they affect on another but (3) the effects are dissipative and (4) the system is cool. These are conditions that seem to be conducive to self-organised criticality typified by sand-pile models [Jensen 1998]. Whilst these characteristics of sand-pile models were identified by Jensen in relation to non-equilibrium statistical mechanics (p. 127), they turned out to characterise a set of agent-based social simulation models that produced emergent, unpredictable episodes of volatility in such series as economic inflation rates, domestic water consumption, market shares. Moreover in every case where a model produced such episodic and unpredictable volatility, corresponding real social statistics obtained after the simulation results exhibited the same statistical features.

We therefore have experience and an evidential basis for designing agents with characteristics 1-3 above.

4.2 Implementations

There are several forms of implementation of metastable socially interacting agents. Most of these forms of implementation stem from the physical sciences and are applied by the school of econophysicists and sociophysicists. These implementations treat individuals as particles or fields with associated distributions of behaviour. The objective is to implement models that produce statistical distributions close to those of observed time-series distributions in (usually) financial markets. Good examples of this approach to social modelling are to be found in the journal *Physica A* in the Econophysics section.

There is also a strand of mainstream economic research (based on ARCH: Auto-Regressive Conditional Heteroskedasticity) that seeks to reproduce observed statistical distributions from (usually) financial-market data in a way that is consistent with rational expectations theory in which it is assumed that every individual in an economy knows the correct model of that economy and, so they all act in the same way as a single representative agent.

From the point of view of the OCOPOMO Project, the central problem with the approach of the econophysicists and the economists is that model validation is entirely at the macro level. Validation turns entirely on the goodness-of-fit of model output with statistical time series or cross-sectional data. A virtue of agent-based policy modelling is that it provides a basis for validation at micro level in the sense that stakeholders can assess whether the behaviour of agents corresponds plausibly to the behaviour of the human and social entities represented by those agents. To validate at both micro and macro level has been termed *cross-validation* [Moss 2005].

Cross-validation is central to a key objective of the OCOPOMO Project which is to engage stakeholders in the provision of scenarios and other information to be used in the design of models and for the outputs from these models to be available to the stakeholders in a form that enables them to assess the plausibility of those outputs. Stakeholders will not generally be able to engage with models and descriptions at such a high level of abstraction that there is no obvious representation of individual behaviour and social interaction. This is a principal reason for using agent-based models in the first place. In addition, the agents must recognisably capture the descriptions of human behaviour and

social interaction as provided and understood by the stakeholders. When applied to historical episodes and statistical data, this process amounts to cross-validation. Well validated models give some confidence that the scenarios produced by those models are not entirely fanciful. If there is some aspect of those scenarios that stakeholders find implausible or just uncomfortable, there needs to be a means of determining how those elements of the scenario were produced and whether they are in fact consistent with the accounts of behaviour and social interaction indicated by stakeholder-generated scenarios and independent documentation.

4.3 Logic-like rule-based implementations

The OCOPOMO objectives suggest a requirement for an agent design that captures stakeholder and other domain evidence in a form that is as close as possible to natural language whilst maintaining the clarity and precision of formal models. A similar requirement is found in expert system technology which is intended to provide end-users with results and explanations for those results in terms that they can readily understand and interpret. The standard approach is to use logic-like, rule-based systems. Experience with expert systems led to the development of agents defined on just such systems for purposes of social simulation.

However, the difference between expert systems and social simulation models is that the rules in expert systems do not change the environment automatically whereas the purpose of agents' rule is precisely to change their environments. For the sake of simplicity and to maintain consistency, soundness and decidability in models, we have adopted an agent design such that each agent approximates an autonomous logical formalism. That is, agents' processors are rule engines that take facts represented as logic-like clauses and put them together according to rules of inference to produce new clauses representing new facts. The input facts are taken from fact bases and the output facts are inserted into fact bases. The totality of the fact bases available to each agent (equivalently, each rule engine) constitutes the environment as perceived by the agent.

By appeal to the Curry-Howard Isomorphism (e.g. Sorensen and Urzyczyn, 2006), any program that runs successfully can be written as a logical theorem and any logical theorem can be expressed as a program. Effectively, each agent is a computer program and so its actions are consistent, sound and decidable with respect to the logical formalism (axioms and rules of inference) of its rule engine. Consequently, agents implemented as rule engines (the processor) with an ability to find facts on one or more fact bases (the perceptor) and to insert facts on the same fact bases (the effector) are logical formalisms proving theorems. Such agents are said to be *declarative*. In addition, the facts can be couched in semantics that are recognisable by end-users.

Our aim is to use these semantics and declaratively modelled agents to produce behaviour and social interaction that can be explained in terms that are close to natural language whilst, at the same time, having the clarity and precision of formal logics. In this way, we will have the richly expressive but generally high-

level scenarios produced by stakeholders for them to compare with the less expressive but detailed and precise scenarios produced by the models.

The foregoing line of argument led to the decision to design agents as declarative computer programs. But this, of course, isn't enough. The point is not to produce formally generated scenarios but also to communicate the essential aspects of those scenarios to end-users in the manner described in chapter 2.1.

4.4 Relationship to FIPA Standards

The Foundation for Intelligent Physical Agents (FIPA) was founded in 1996 as a non-profit organisation with the aim to promote "technologies and interoperability specifications that facilitate the end-to-end interworking of intelligent agent systems in modern commercial and industrial settings" [FIPA 2003]. While agent-based simulation is clearly not the focus, it is officially included in their efforts. The FIPA platform interoperability standards comprise a set of specifications, which define the required agent communication language, agent management facilities, and non-agent integration facilities [Poslad et al. 2000].

Adhering to FIPA standards does not benefit the agent-based simulation models developed in the OCOPOMO project; for the following reasons:

1. Agents in OCOPOMO are heterogeneous in that each model comprises several different agent types (e.g. in the case of the Kosice pilot study households, enterprises, municipality, government and NGOs), which differ in their behaviour (set of rules) and attributes (set of facts). But they are developed by the same team of modellers, who will adhere to one agreed "protocol" of communication.
2. All agents operate in the same environment, namely the simulation model. In contrast to open multi-agent systems, this environment has been developed by the same set of people as the agents. In fact, the model is being developed at the same time as the agents, thus ensuring that interfaces between agent and model are developed in accordance with each other. The need for a pre-defined set of (communication) operations, which all agents have to adhere to in order to function in the given environment, is therefore low.

While FIPA might be the best known standardisation effort in the multi-agent community, it is not the only one. There is a significant amount of work related to agent-based simulation architectural interoperability [North et al. 2006]. This includes the High-Level Architecture (HLA) and the Distributed Interactive Simulation (DIS) protocol [IEEE 2010, IEEE 1996, IEEE 1998]. These approaches are focussed on the re-use of model components and distributed execution of simulation models. While both of these goals have their merits, particularly with regard to scalability and speed of execution, the cost of implementing them in OCOPOMO outweighs their potential advantages by far.

5 Prototype models

5.1 Kosice model

The prototype model of the Kosice case study covers the subject of energy policy: electricity and heating. The focus is on three issues, namely energy efficiency, decrease of energy consumption and utilization of renewable energy sources in the Kosice Self-Governing Region (KSR).

The main aim of the prototype model is to capture the behaviours of key stakeholders and the process of decision making in the energy domain. The prototype model is designed to combine interrelations between the local environmental as well as spatial determinants, economic conditions and realistic social dynamics that allow for testing the effectiveness of various government policies under different conditions such as abnormal climatic phenomena or changes in the availability of raw materials like gas, coal, biomass etc.

The development of the Kosice prototype model is based on data obtained in the process of consultations with the local authorities of KSR and an analysis of documents, which were prepared in WP 1, delivered by the use case partner or gathered via desk research. The most significant documents that served as an evidence base for identification of agent types, their actions and conditions as well as the creation of rule bases and fact bases are listed below:

- Documents created within the OCOPOMO project
    - Description of the Kosice pilot case, pp. 22-45 of Deliverable 1.1 [Bicking et al., 2010]
    - Description of the pilot model from Warsaw team
    - Analysis of Structural Funds (2007 - 2013) and Projects Approved in 2009 in the Kosice Region (see section 9.2.1**Fehler! Verweisquelle konnte nicht gefunden werden.**)
- Documents acquired via Internet
    - Energy policy of the KSR (2007): http://www.vucke.sk/APIR/sk/Pre_Podnikatelov/Investicne_prostredie/energetika/Stranky/default.aspx
    - Strategy of the Renewable Energy Sources Utilization in the KSR (2006): http://www.vucke.sk/APIR/sk/Pre_Podnikatelov/Investicne_prostredie/energetika/obnovitelnezdroje/Stranky/default.aspx
    - Demographic composition of households (1996): http://wdi.umich.edu/files/publications/workingpapers/wp377.pdf (Table 6)
    - Annual Report 2009, Regulatory Office for Network Industries: http://www.urso.gov.sk/doc/vs/VS2009.pdf
    - Regional Statistics Database: http://px-web.statistics.sk/PXWebSlovak/index_en.htm

Kosicky Kraj in Figures 2010 Statistical Office of the Slovak Republic

- Interview transcripts, emails
    - Answers to questions posed via email, 19/11/2010, file scott_odpovede.doc

5.1.1 CCD

Figure 11 shows the ontology for the Kosice case study. Agents (actor entities) are marked in colour. Two types of relationships are differentiated: hierarchies ("hollow" arrow) and dependencies/associations (simple arrow with label, e.g. "uses", "owns").

The specification of agent types, rule bases and fact bases is as follows.

5.1.1.1 Agent types and descriptions

The agent types as well as their actions and relations are represented in the model as outlined in the ontology. The currently rather simple interrelations will be expanded in consecutive and more advanced versions of the model.

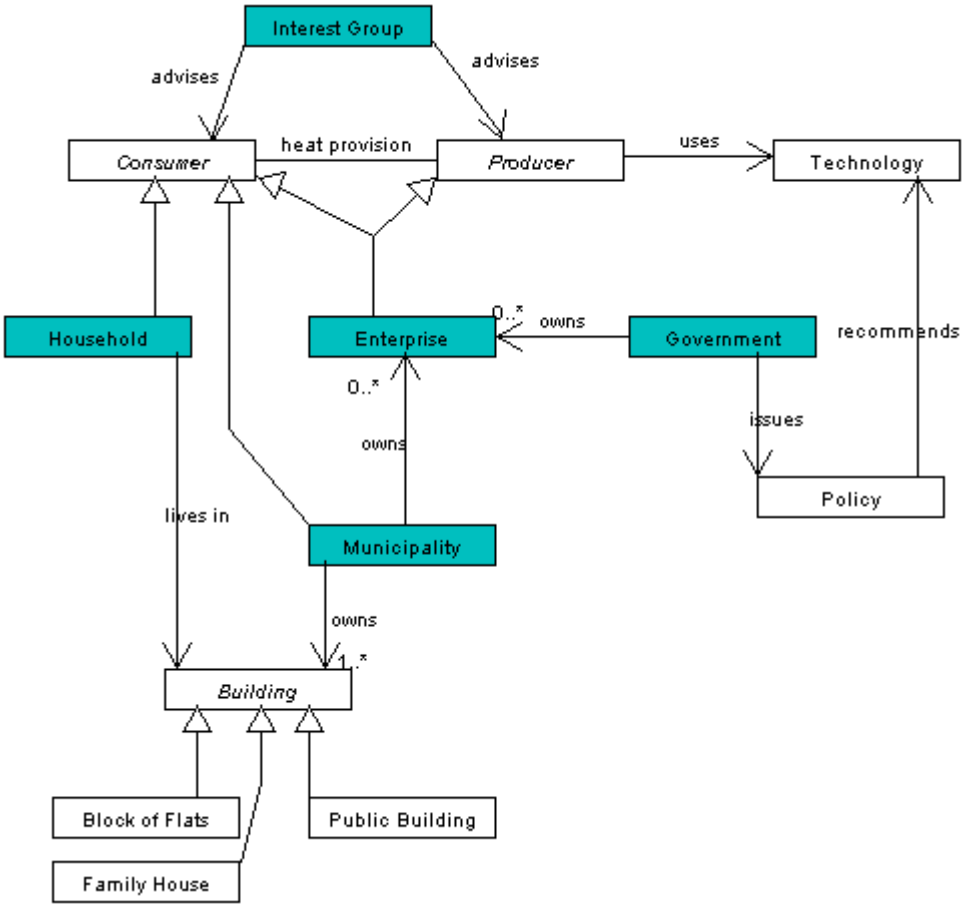


Figure 11: Kosice model ontology

For the initial Kosice model reflecting the issue of energy policy in KSR two main agent types have been distinguished, namely households (consumers) and

enterprises (both consumers and producers, but also know-how and technology providers). Each agent type has different aims, beliefs, and tools and operates under different conditions. Policy-related decision makers (EU, national government, municipalities) and, to a lesser extent, interest groups are treated in the prototype model solely as source of control parameters, determining the boundary conditions.

The brief description of agents is as follows.

Household: A household is living either in an individual house or in a flat in a block of flats. Owners of flats are obliged to form associations. The association hires a service company, which is responsible for agreements with heat and electricity providers. An association may refuse to cooperate with the service company and make arrangements with energy providers on its own. All households are energy consumers; the majority of households in blocks of flats receive energy from central providers. A small minority owns individual boilers to produce their own heat or windmills to produce electricity.

Criteria for decision making with regard to renewable technologies are that the technology is affordable/not affordable, profitable/uneconomical, recommended by a neighbour, recommended by the government, recommended by an interest group etc.

Available actions:

- Insulate house
- Change saving behaviours (e.g.: by lowering the thermostat, closing and insulating doors and windows, changing daily patterns of electricity use)[1]
- Install solar panel
- Install heat pump
- Install windmill
- Change supplier

Relevant conditions:

- Owns house OR block of flats associations agree
- Reduction in heat/electricity cost is significantly high
- Insulation/investment is profitable
- Installation is affordable
- Technology is recommended by significant number of other stakeholders

Enterprise: An enterprise in the prototype model is either an energy (heat and/or electricity) producer or an energy consumer. Energy producers are

[1] The prototype model may attribute saving behaviours to consumers as a single value, e.g. “percentage of implementation of all possible saving behaviours” depending on “saving attitude”. Modelling saving behaviours is actually quite complex and will be elaborated in subsequent versions of the model.

assumed to provide the heat or electricity for their own demand, thus reducing their output accordingly, instead of receiving energy from a different energy producer. Enterprises have a size (large, SME) and an owner (state, municipality or private). If they are energy producers, they apply a particular energy technology.

Criteria for decision making with regard to renewable technologies are that the technology is affordable/not affordable, profitable/uneconomical, recommended by the government, recommended by an interest group, requested by the owner (in case of public enterprises).

Available actions:

- Insulate building
- Change saving behaviours (e.g.: lowering the thermostat, closing and insulating doors and windows, changing daily patterns of electricity use)
- Install new gas boiler
- Install biomass boiler
- Install solar panel
- Install heat pump
- Install windmill

Relevant conditions:

- Installation is feasible (affordable AND in accordance with government policy)
- Technology is recommended by significant number of other stakeholders

Specific enterprises to be represented in the model:

- TEKO (state-owned, heat producer, large)
- TEHO (municipality-owned, heat producer, medium-sized)
- KOSIT (municipality-owned, heat producer/incineration plant, medium-sized)
- SPP – Slovak Gas Industry (owners: Slovak Republic, Gas Holding B.V. – consortium of E.ON Ruhrgas and Gaz de France)
- SE (Slovenské elektrárne) – Slovak Energy (owners: the National Property Fund and the company ENEL SpA). Biggest electricity producer in Slovakia; the line of business comprises also electricity imports, exports, sales and distribution
- SES a.s. (Slovenské energetické strojárne) – Slovak Energy System (majority shareholder is Segfield Investment). SES is the leading supplier of boilers for both power and combined heating and power plants, incinerating plants
- RWEGas Slovensko (private enterprise); gas and electricity provider

Other enterprises will be chosen randomly, as their individual influence is smaller.

Municipality: A municipality owns public buildings (town hall, schools, hospitals…) and is thus a heat consumer. It may also own heat-producing enterprises.

Criteria for decision making with regard to renewable technologies are that the technology is affordable/not affordable, recommended by the government, recommended by an interest group.

Available actions:

- Insulate public buildings
- Install solar panels on public buildings
- Install heat pump
- Install biomass boiler
- Request owned heat producing enterprises to switch to renewable technology

Relevant conditions:

- Installation is affordable / budgeted
- Renewable technology is recommended by government

Specific municipalities to be represented in the model:

- City of Kosice

Government: The government issues policies to influence the behaviour of other stakeholders (municipalities, enterprises, households). With regard to the issue of renewable energy, such a policy will comprise recommendations for technologies applying renewable sources (biomass boiler, solar panels, geo-thermal heat pumps), enhancing energy efficiency as well as decrease of energy consumption.

Available actions:

- Request owned heat producing enterprises to switch to renewable technology
- Issue renewable energy policy recommending certain technologies for particular actors
- Support energy consumption via loans and donations

Interest group: Interest groups such as NGOs, consumer associations or the Chamber of Commerce advise their clientele on the topic of renewable energy technologies. This may or may not be in accordance with the government policy.

Available actions:

- Recommend technology

The prototype model includes only abstract government, municipality and interest group agents and treats them solely as a source of control parameters. Later versions will expand this.

5.1.1.2 Rule bases

The rules for the prototype model are specified in natural language. One of the reasons for this is to replicate the actual process of the OCOPOMO approach, where stakeholders are to create scenarios in natural language, from which, via structuring and formalising the information in the CCD, the model will be developed. Another, related reason is that the modelling team found it easier to communicate with the domain experts during the process of specifying the rules. Rules in pseudo-logic – while still using the stakeholders' terminology – were ultimately too abstract for the latter to comprehend and discuss.

Rules depicting change in knowledge, attitude and engagement of consumers

The consumers acquire knowledge by education, social campaigns, information programs, information from neighbours etc. Their attitude toward particular technology is changing according to received opinions.

NOTE: It is crucial to distinguish two types of attitudes: important and unimportant. For instance important attitude may be one that is related to money or one that is highly promoted in media. Important attitude has a bimodal distribution and changes in a discrete way. Unimportant has normal distribution with "indifference mean" and changes continuously.

- If there is an educational project in schools about power or heating saving behaviours, it is possible that in some families new behaviours will be adopted.
- If government/producer/interest group/NGO starts to advertise new environmental-friendly technology, the consumer's knowledge of this technology increases and consumer's attitude to this technology may became more positive.
- If there is a social campaign about new power or heating technology or energy saving behaviours, the consumer knowledge of this technology or energy saving behaviours increases and consumer attitude to this technology may became more positive.
- If there is news about possible or present gas crisis, consumer starts searching for alternative heating source.
- If a neighbour starts to use technology that produces energy from renewable sources, the consumer's knowledge about this technology increases.
- If a neighbour is satisfied with his/her new technology, the consumer's attitude to this technology is more positive.
- If a neighbour is disappointed with his/her new technology, the consumer's attitude to this technology is more negative.

- If some information about drawbacks of environmental-friendly technologies appears (like geothermal/wind/solar energy is expensive, ineffective etc.), the consumer's knowledge about eco-technology increases but not in a way that favours energy from renewable sources.
- If the consumer does not use the particular technology nor receive new information about it from the media or from the neighbours, his/her knowledge of this technology falls (decreases along the "forgetting curve") and his attitude toward the "green" technology becomes less and less important (going to the "I have no opinion" state).
- If the consumer uses the particular technology, his knowledge of this technology rises along the sigmoid function and his attitude becomes more important (going to the state "It is good" or "It is bad" or switching between those two states).
- When consumer fails to implement the particular preferred technology (due to the lack of supplier, lack of funds, unexpected changes in economically significant conditions during implementation or usage), his attitude becomes more important and switches to the state "It is bad".
- Every technology requires some involvement from the consumer, that is, some technologies and behaviours are more time-consuming than others. For example gas used for heating doesn't need any significant involvement from the user, the timber heating needs a lot.
- The technology that is more time consuming is less preferred by consumer. But this effect is weaker when the consumer's attitude toward this technology is highly positive.
- The behaviour which doesn't need a lot of involvement is easier to adopt for consumer.

Rules depicting consumers' behaviour

NOTE: Consumers do not perform rationally. Consumers prefer not to change anything even if it may be somehow beneficial to them. But there are several events which create the opportunity for change:

- If electricity or heating price increases by a significant amount (for instance, the price has to rise at least by 20% to be noticed by consumers - magic fact), consumer starts to use already known energy saving behaviours.
- If heating costs are rising substantially, consumer starts to think about alternative heating sources and insulation improvements.
- To improve insulation the consumer needs to have enough money to do this.
- The consumer improves insulation during general renovation of house.
- The consumer improves insulation to obtain better energy efficiency certificate.

- The consumer improves insulation after her/his heating cost rises substantially.
- The improvement of insulation is one of many saving money technologies to be chosen.
- The consumer selects from technologies that he/she is familiar with.
- The consumer selects from technologies which are available for her/his place of leaving. (e.g. the fireplace cannot be installed in block of flats in city centre).
- The consumer needs to have positive attitude to technology to select it.
- The consumer needs to have enough money to change the technology.

  NOTE: The cost of technology is a parameter of technology.
- The consumer prefers technology that is easy for implementation and maintenance.
- When consumer plans to invest money in e.g. general renovation of house, she/he selects the best available heating technology for him.
- If two technologies have similar or comparable costs of implementation, the consumer selects this with higher attitude.
- If consumer has similar attitude to different technologies, he/she selects the cheapest.
- Consumers with high motivation to money saving select the best economically option.
- Consumers with high motivation to sustain comfort of living select less involving option.
- Consumers with high eco-friendly motivation select best ecological option.
- When two technologies are similar (taking into account attitude and adaptation) and possible to manage (investment price), the consumer selects technology with better payback period.
- If the subvention for particular technology (i.e. EU or government subventions) is introduced, consumer attitude to this technology changes to more positive (decreased the cost of change).

Rules for know-how transfer and knowledge dynamics

One of the very important aspects of economic calculation is the availability of know-how. The ability for the enterprise to perform/ complete a task depends on the number of skilled workers.

NOTE: There is a lower (and upper) knowledge limit required for particular technology. For instance enterprise that produces and installs coal boilers may hire few trained technicians to start the business. To install the big wind turbines at least one engineer and few technicians are required; to build power plant the whole design unit/office must be involved. Number of projects realised in

parallel is similarly a function of number of trained employees and particular technology.

- If the company is conducting business in particular area, its aggregated know-how in this area is growing as the sigmoid function and reaches saturation, unless company is engaged in research and development domain (in R & D the process is much more complex).
- If the company ceases activity in a particular field, its know-how is disappearing according to "forgetting curve" (even if the employees remain in the company).
- If the company decides to reduce workforce, its know-how decreases more or less proportionally (inversely to sigmoid function) to the number of fired workers compared to the previous number working in this area.
- If the company decides to hire already trained workers, its know-how increases almost proportionally (magic fact) to the number of hired workers (compared to the previous number working in this area).
- Experts made redundant by other companies are cheaper than those taken directly from another company.
- Unemployed professionals are losing some of their skills gradually according to the "forgetting curve".
- New employees do not bring in all their competences – an important part of their expertise is "left" in the previous company (with old customs, co-workers, tools).
- If the company decides to buy another company to get its know-how, or merge with the other company, such losses are smaller, but still exist.
- If the company decides to hire untrained workers, its know-how decreases more or less proportionally (magic fact) to the number of hired workers (compared to the previous number working in this area), but then it may gradually increase the know-how via internal knowledge transfer, and finally be able to accomplish more tasks in parallel.
- The company may invest in external training for employees, but when calculating costs, it takes into account the number of persons to be trained, required time of training (during the training the employee does not work for an employer).
- When the company decides to change the business profile or add a new branch too its activities, know-how is initially proportional to the similarity between old and new activities and the number of workers transferred to new branch of business.

Rules describing economic calculation

- Usually investors are idle and do not like change; neither do they like the risk accompanying change (with regard to changes people vary - normal distribution).
- Investors are looking for new investments in energy domain, when e.g.:

  - they are compelled to do so by decision of the government (either direct when the state is the owner of the buildings/plants etc., or indirectly through new legislation)
  - when they have extra money that can be spent on investment in new technology or insulation
  - when anticipating future profits/savings from investments in new technology (increased profitability of business, tax reduction or subsidies).

- The government subventions supporting particular technology make investment more attractive.

  NOTE: If the investor needs to obtain additional funding for the planned investment and the technology is new (or unverified in case of novelty), it is difficult to obtain commercial credit for it. In this case the government's grants, funding or guarantees strongly support eco-friendly undertakings.

- The calculation of cost-effectiveness of technology must take into account:
  - costs of investment and exploitation
  - cost of know-how (important for producers, but also for consumers, especially large companies which have their own service team)
  - realisation period (how long investor has to wait and pay without profits) - time may vary depending on technology
  - Time from last investment in particular area (as consumer rather do not want to completely change installations which are still operational and with payback less than 60% - magic number - similarly the investors do not want to abandon technology, which may still be profitable)

  NOTE: To calculate the cost-efficiency of technology, the table will be created with data indicating exploitation costs, investment costs, payback time etc.

- The enterprise chooses the available technology with best payback period depending on individual preferences of its board of directors (decision making body).

Rules depicting eco-friendly motivations and trends

- The enterprise which invests in green-technologies creates positive image among its customers and business partners.
- Customers with high ecological motivation select enterprises which use clean technology.
- Employees sensitive to the needs of natural environment may perform better while working in the green business.

- The company that adopts and promotes green-technologies intensively is likely to be more popular than "not that clean" competitors - people ecologically oriented may selflessly promote information about it.
- The company abandoning the green technology is likely to lose much more in the eyes of customers and employees than eco-friendly competitors.

Rules depicting decision making process

- If enterprise/ consumer wants to implement new technology, but he/she is not able to take the final decisions due to lack of formal possession (e.g. state or municipal enterprises, tenants and users of real estate, members of housing cooperatives) or due to fragmentation of property rights (e.g. co-owners of buildings), then he/she may influence (put pressure on) the decision-making agent (government, municipality, owner, council of cooperatives, the council of building association etc.). His/her preferences may also be manifested during the referendum or election to decision-making bodies.
- In case of associations of flat owners, if 60% members vote for the change, then it should be implemented.
- Every decision has a rational component and a component related to the social influence, but decisions taken collectively have also a political components (board members can represent the government, political parties, lobbyists or the shareholders of the particular company) and procedural components (e.g. voting system), hence:
    - Board members may not be personally interested in economic aspects of the decision, but more care about political aspects or their beliefs.
    - The extreme pro-environmental attitude allows one to accept even the most expensive green-investments
    - The high "pro-profits" attitude cause the aversion to long-term investments (both for investors, entrepreneurs and managers, as well as for ordinary consumers)
    - Politicians avoid decisions that might jeopardize their chances in forthcoming elections or bring political benefits to competitors
    - Politicians may take a decision that favours their sponsors (business/interests groups)

  NOTE: In prototype model only individual owners and decision-makers will be taken into consideration.
- Both consumers as well as entrepreneurs may easily go back to the old technology, if the new technology proves to be unprofitable - they still have knowledge and some of them kept most of the old installations (cf. the case of Zakopane, where people went back to use coal heating which is now two times cheaper than gas and about three times than centralised geothermal heating).

Examples of technology rules

A technology is possible/available when technical and juridical studies undertaken for a particular area and/or house allow the use of a particular solution:

- to use gas heating or centralised heating (e.g. from CHP) the pipe has to be present in near surrounding (more costly and troublesome alternative is fuel gas tank)
- usually classic geothermal heating is not available (too expensive) on the individual level
- for "horizontal" heat pump the house has to be surrounded by rather large and empty area
- for "vertical" heat pump quite deep drilling is needed
- some types of heat pumps needs to be located near water
- local wind or hydroelectric power station should be nearby (few km. depend on size and number of users.
- hydroelectricity may be generated only when dam is available or possible
- for solar panels and small windmills investor has to have access to the roof
- wind farms require large areas on the top of hills or mountains
- bigger windmills should be at least 0.5 km (magic fact) away from other buildings
- installation of ovens, fireplaces, individual biomass (pellet) boilers, tanks for oil, windmills may be prohibited in the city centre

5.1.2 Model

The prototype simulation model implements the conceptual description using DRAMS and RePast/Java. Additional data necessary for the initialisation in order to create agents of type household, enterprise, municipality and interest group is taken from the raw data or made up randomly if not available ("magic numbers/ facts"). An overview of extracted information can be found in section 9.2.3.

When analysing the energy policy and possible decisions of actors in this domain, the natural conditions of the Kosice region have to be taken into account. Terrain, location of and distance from renewable energy sources, concentration of housing, available infrastructure etc. are important issues highly influencing the output of the model. To assure that the prototype model corresponds to reality, a grid (see Figure 12) depicting key features was developed:

- High-density housing consists of buildings where there are serious limitations to utilizing alternatives to gas/coal energy sources. For the prototype model we assume that only gas and central heating systems are used.

- Areas of low-density housing accommodate the population in more spaciously set out housing with green space between houses. The range of possible gas/coal alternatives (heat pumps, biomass boilers, fireplaces, wind mills etc.) is wide.
- Combined Heat and Power Plants (CHP) are distance sensitive.
- The gas infrastructure is centralized, which means that parts of the region far away from the main pipelines do not have access to gas.
- There are several geothermal sources in the Kosice region, thus providing huge potential for utilization of geothermal energy for heating.
- Rivers and lakes are important features with regard to water plants, energy crops and some types of heat pump.
- Level fields are possible locations for energy crops; straw from grain crops growing there might be considered as waste biomass.
- Fields on the hills are possible locations for wind mills.
- Mountains in KSR are of moderate altitude.
- 40% of Slovakia is covered by forest; it may be utilized as biomass source.

The distinguished characteristics, although significant, are not complete and will be supplemented in subsequent stages of model development.

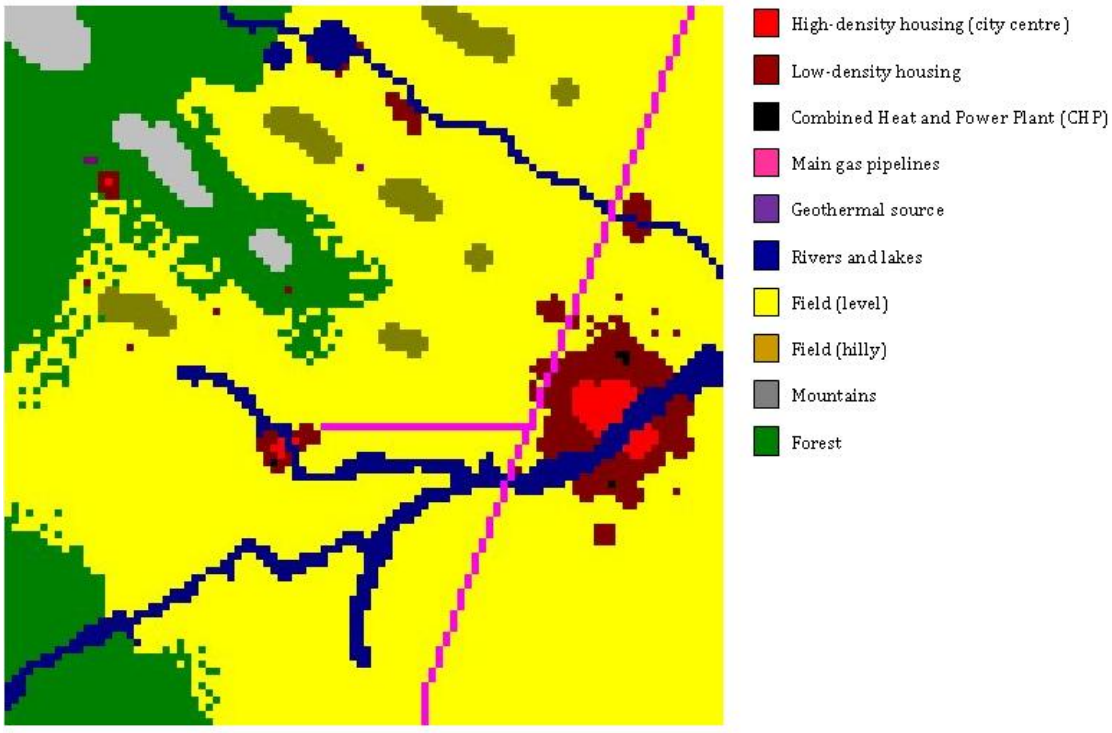


Figure 12: Grid (100x100 cells) depicting key features of the KSR region

5.2 Campania model

The Campania prototype model will investigate a policy of establishing competence centres in order to support the development of industrial clusters

within the Campania Region (Europe Area Project). The first phase of this undertaking has been completed with the foundation of ten regional competence centres for different sectors.

The focus of the prototype model will be on the sector of cultural heritage and environmental monitoring, thus involving the regional competence centre Benecon. It will look at the third phase of the Europe Area Project, where new and sustainable activities are to be financed.

The prototype model is intended to capture only the creation of consortia submitting proposals for such activities (projects) in this sector. The later versions of the model will explore the effectiveness of competence centres in the establishment of synergistic industrial clusters.

As the document reproduced as section 9.1.3 states,

> The establishment of regional networks / clusters may represent an adequate solution for the promotion of research, technological development and innovation by focusing - on the one hand – on the promotion of territorial excellences and – on the other – on the processing of knowledge and experience acquired in new solutions.

Consequently, the purpose of the first prototype model is to lay the ground for a simulative investigation of the above hypothesis.

5.2.1 Raw data

The basic documents containing the evidence from which the first prototype model is being built are reproduced in the appendix, section 9.19.1. These documents indicate that the agents involved in consortia are universities, research centres and enterprises. The skill sets required for a particular call for proposals are specified by the planning authorities. There are some constraints as to the composition and funding of successful project proposals: they must be based on a cross-fertilisation between the worlds of research and business, and the business partners will have to provide 50% of the funding.

5.2.2 CCD

The following diagram shows the agent types identified for the prototype model (Figure 13). Some agent types include specific agents, like the seven different universities in the region and the competence centre working in the sector of cultural heritage (Benecon). The planning authority is represented as a single agent.

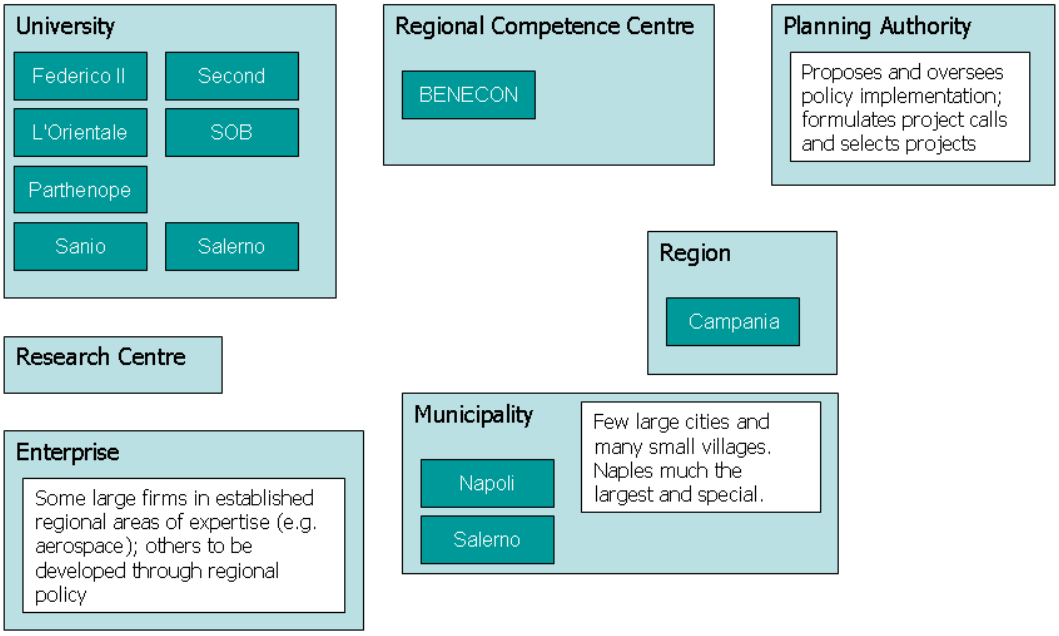


Figure 13: Campania model agent containers

The corresponding ontology (see Figure 14) for this model includes skills, consortia, calls for proposals (project calls), clients and technologies – both in use and prospective. Actors (agent types) are marked in colour. Two types of relationships are differentiated: hierarchies ("hollow" arrow) and dependencies/ associations (simple arrow with label, e.g. "uses", "requires").

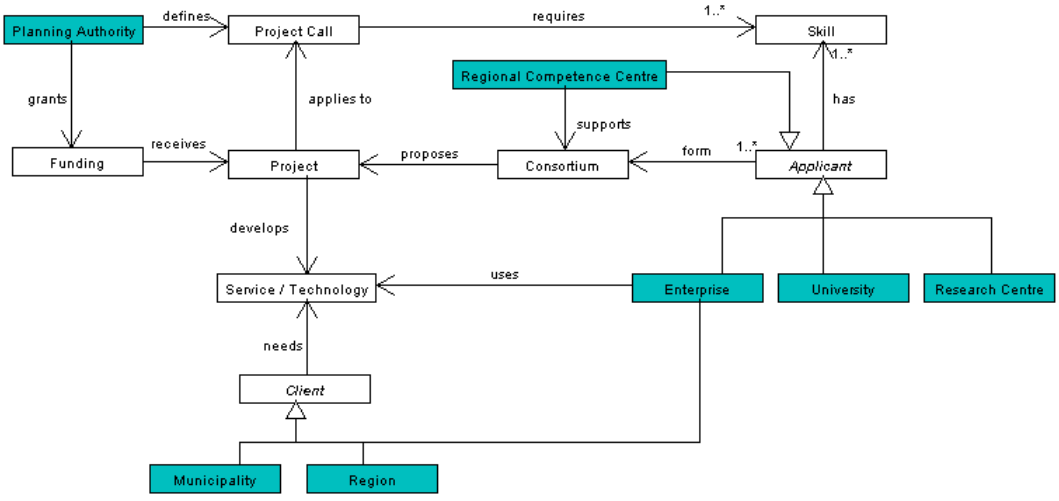


Figure 14: Campania model ontology.

The third main component of the CCD is the description of the rules governing the behaviour of each agent type. This takes into account available actions and the decisions agents make with regard to those actions based on particular conditions.

5.2.3 Model

The prototype simulation model implements the conceptual description using DRAMS and RePast/Java. Additional data necessary for the initialisation in order to create agents of type university, enterprise, research centre, municipality, regional competence centre and planning authority is taken from the raw data or made up randomly if not available ("magic numbers/facts").

5.2.4 Model output

The model produces both narrative and visual output. Each simulation run produces a so-called *trace* of the model execution, which contains detailed statements from every rule that fired including its time of execution, the agent it belongs to and the facts that were involved. From this a narrative can be extracted that is readable for stakeholders, thus enabling them to validate the modelled processes.

Graphical output will be in the form of social networks, to visualise the dynamic social networks evolving between actors in the simulation. An example for this type of output is the links developing between enterprises and universities that have been partners in a joint project. Future versions of the model may include other visualisations like a map of the Campania region where the geographical location of each involved enterprise is shown. This would allow to easily investigate if the policy's goal of establishing industrial clusters is achieved.

5.3 Macroeconomic model

The purpose of the macroeconomic model is to generate relevant context for the policy models to the extent that stakeholders believe the economic environment influences their local and/or non-economic policy options. The model is not integrated with the regional policy models on the grounds that, whilst macroeconomic events affect regional resources and constrain regional behaviour, the effect of regional behaviour on the macroeconomy is unlikely to be significant.

An important feature of the macroeconomy for regional policy formation is the associated uncertainty. In practice, major economic events such as credit crises, stock market crashes or waves of industrial bankruptcies are never accurately forecast. And national government responses may depend on the precise nature of such events. The use of output from a properly formulated macroeconomic model is intended to encourage stakeholders to consider the robustness of their preferred policy measures in the face of unpredictable volatility in the social and economic environment.

The core model itself is simple. There are just four type of agents – government, bank, firms and households. There is one government and, for the present at least, only one bank. The numbers of firms and households can be set by the user at the start of a model run. The agent container diagram is depicted in Figure 15.

The corresponding ontology diagram is depicted in Figure 16. As in all of the models, the agents are special objects in that they are defined on rule- and fact-bases with a rule engine.

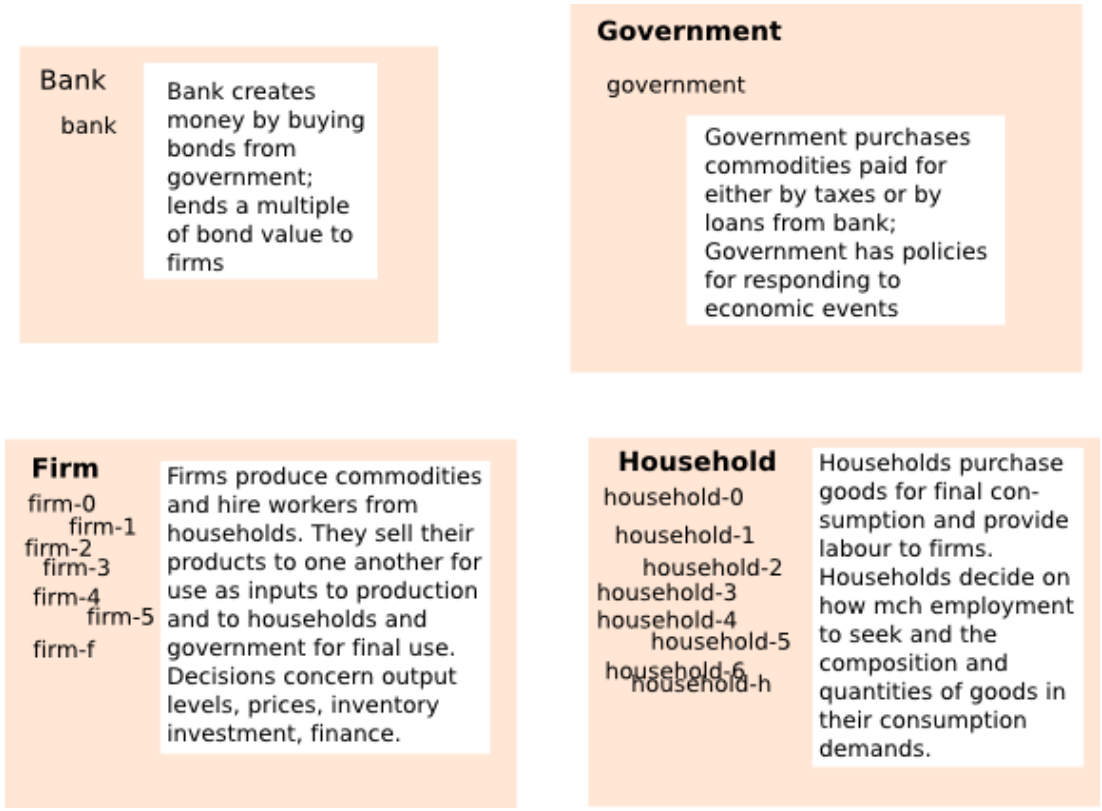


Figure 15: Macroeconomic model agents container diagram

The fact templates corresponding to the ontology are those for entities and those for actions. The entity fact templates include those for production processes, bond and money holdings, debts, employments of labour. The actions include transactions in goods, bonds and labour.

The third element in the CCD interface is the description of the rules and the rule dependency graphs for each agent type. We are not producing mock-ups of the manually generated dependency graphs in this document since we can show the calculated graphs from the prototype macroeconomic model produced using the DRAMS software. This full data dependency graph including both fact templates and rules is reproduced in Figure 17. The design of this graph will be produced by users of the toolkit and will then be compared with the graphs calculated by the DRAMS rule engine manager.

This is a verification process demonstrating that the model design is formally consistent with the implemented rules. Though not an element of the OCOPOMO Project, the inclusion of an ontology reasoner in the toolkit would ensure that the design itself was formally correct and, if the implemented rule base conforms to the designed rule base, then the design and the implementation should be mutually consistent and so consistent with the ontological formalism.

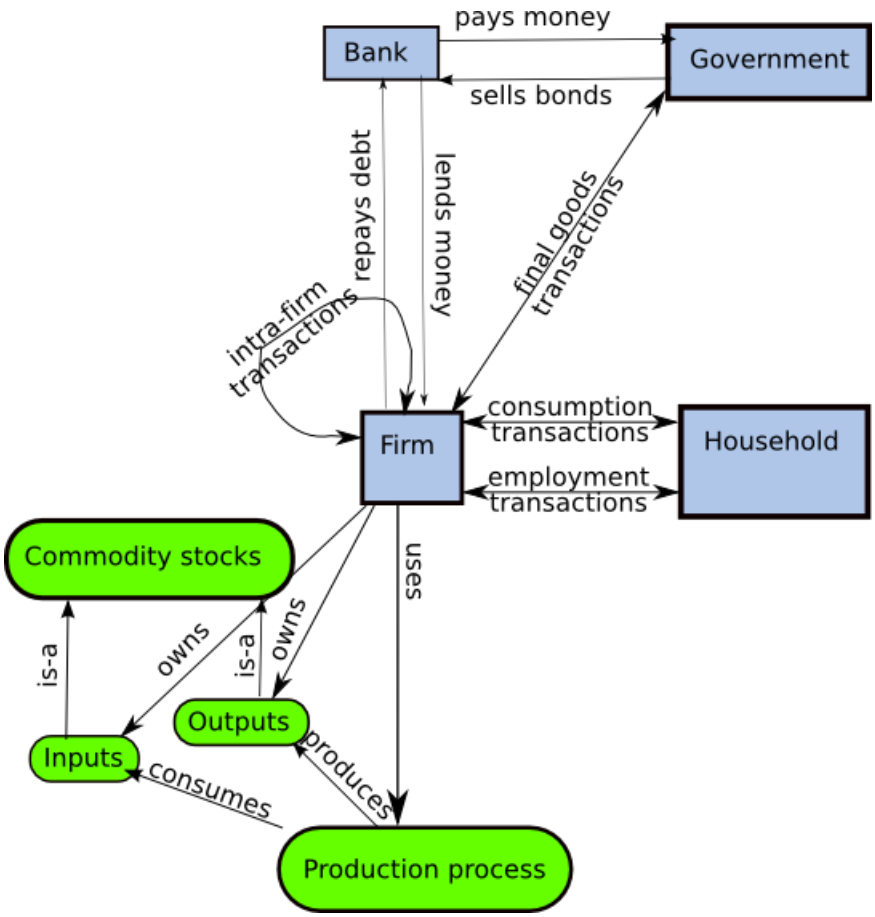


Figure 16: Ontology diagram for macroeconomic model

It remains for us to explore whether the design rule base in the CCD can provide templates for the DRAMS rule bases. This would be a desirable feature of the toolkit but not essential to prove the feasibility and value of the OCOPOMO policy analysis process.

The set of commodities produced, consumed and traded amongst agents in the model is determined by the model operator. Some of the commodities enter directly or indirectly into the production of all of the commodities. These commodities are said to be *basic*. The others are *non-basic*. The model operator specifies the number of basic and non-basic commodities, the number of firms and the number of households. Within the constraints of the numbers of basic and non-basic commodities, the production processes, specifying how much of each input commodity is required to produce a unit of output, are determined at random. An input-output matrix $\mathbf{A}_{ij}$ is produced where the elements of the matrix are the quantities of commodity *i* required to produce a unit of commodity *j*.

There is a well established body of mathematics of non-negative square matrices that enable us to ensure that the technology described by the input-output matrix is productive in the sense that more of every commodity can be produced than is required as inputs for the economy as a whole.

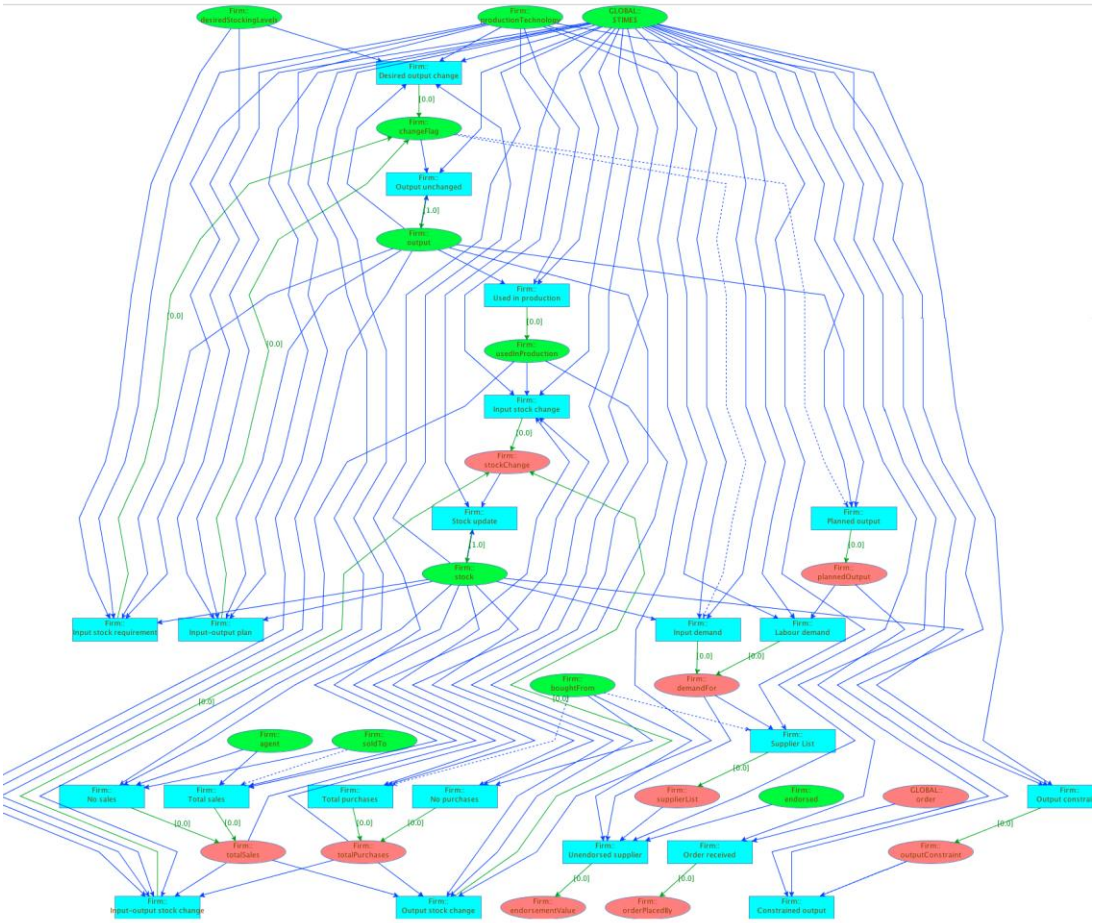


Figure 17: Prototype macroeconomic model data dependency graph

5.4 London Housing Model

At a late stage in the work on WP5, our partner Volterra Consulting became convinced that the OCOPOMO process is of significant value for commercial exploitation and asked if we would be willing to add a further test case. The case they suggested concerns housing policy in London. This is a very much more difficult case than either the Kosice or Campania cases because it involves some 30 London boroughs, each being a separate planning authority, and the Greater London Authority which is responsible for a strategic housing plan and its implementation over all of the boroughs. There are deep political issues, issues of control and authority, endemic human welfare issues and economic issues stemming currently from cuts in government spending including subsidies to local government.

We held a preliminary meeting with representatives from the office of the Mayor of London, housing authorities, the national ministry and housing consultants. Even the preliminary discussion was held by the participants to be extremely interesting and useful so that, starting in the first quarter of 2011 we will begin development of the CCD and model to explore with the many stakeholders the

best means of coping with the perennial shortage of housing and high housing costs in London. This additional element in the project will naturally involve some further contribution of resources which will be provided by Volterra and SMA who expect to work together with, if so wished and agreed, by other members of the OCOPOMO consortium after the project to develop the OCOPOMO process as the basis of a commercial venture.

The main stakeholders in the London housing case are the Greater London Authority (GLA), the 33 London boroughs, The Housing and Community Agency (HCA), banks and finance houses, independent housing associations, NGOs for the homeless (Shelter) and others (Citizens Advice Bureau). The GLA is responsible for formulating a housing strategy for all of the boroughs but the boroughs themselves control the planning processes and so decide what housing can be built and where. The HCA has the public investment funds and has the responsibility for implementing the GLA strategy. Some housing is built by private developers, some by housing associations and some by the boroughs themselves. Different boroughs have different priorities.

Evidently, there is a range of key stakeholders and any successful policy implementation requires some coordination amongst the stakeholders. By promoting ongoing discussion without a large number of meetings in person, the OCOPOMO process and toolkit may not only bring precision and information to the discussions but may also allow for discussion to take place in a manner that is efficient and effective. An interesting research question here is the extent to which the leading stakeholders (especially the GLA and borough councils) will allow the collaboration to be open as well as effective and efficient. This is a political judgement on their part and one which all systems of open collaboration will have to take into account. Indeed, an important question is whether the OCOPOMO process can be instrumental in generating the confidence among such stakeholders that is essential to an openly collaborative process.

6 Refined requirements list for tool support in scenario-building and policy modelling

Based on the experiences with developing the prototype models for the case studies some of the requirements for the ICT tool box specified in Deliverable 1.1 [Bicking et al. 2010] and 2.1 [Mach et al. 2010] had to be refined. This concerns in particular the specification of rules in the CCD. While it was possible to engage stakeholders in the process of specifying rules for different agent types, it had to be done solely in natural language. Rules in pseudo-logic – while still using the stakeholders' terminology – were ultimately too abstract for the latter to comprehend and discuss.

Requirement ID: CCD-1 **Requirement Type:** Functional **Priority:** Must-have
Name: Natural language rule specification

Description: Interface for stakeholders to specify rules for different agent types in natural language.
Measurement indicators: Function available
Refines: PM (Transformation process) – Rule generation

Requirement ID: CCD-2 **Requirement Type:** Functional **Priority:** Must-have
Name: Rule generation
Description: Interface for modellers to transform rule specifications from stakeholders in natural language to more formal representation of logic-like rules in pseudo-code.
Measurement indicators: Function available
Refines: PM (Transformation process) – Rule generation
Requirement ID: CCD-3 **Requirement Type:** Functional **Priority:** Must-have
Name: Audit trail from natural language rules to pseudo-code rules
Description: Keeping audit trail (links) from natural language rule to pseudo-rule to rule in model..
Measurement indicators: Function available
Additional requirement

7 Conclusions

As stated in the technical annex [OCOPOMO 2009], successful integration of policy modelling and scenario analysis for use by stakeholders and policy operators has not, as far as we know, previously been attempted. Certainly, the design, implementation and running of such models has informed scenario analysis and role playing games and therefore influenced stakeholders indirectly. To achieve the direct engagement of stakeholders with policy modelling and to

use that engagement in the development of complementary scenarios amounts to significant progress beyond the state of the art not least by demonstrating a whole new approach to the use of models and scenarios in policy formation.

The successful completion of work package 5, *Policy modelling and scenario process design,* is a big step in this direction. The collaborative scenario development process together with the rule-based design of agents representing individual actors in the chosen type of policy models allow for exactly the kind of stakeholder engagement envisioned in the project proposal.

This deliverable has documented in detail the work undertaken in WP 5, namely (a) the design of agent-based policy models, (b) the specification of rule-based agent design, (c) the specification of the collaborative scenario development process and (d) a refinement of the requirements for tool support in scenario-building and policy modelling.

With work packages 1 [Bicking et al. 2010], 2 [Mach et al. 2010] and 5 [this deliverable] completed, the conceptual phase of the OCOPOMO project has been successfully brought to an end, which provides a sound basis for the following implementation phase. The work reported on in this deliverable will feed directly into both work package 6, implementing the procedures and conceptual pilot models devised, and work package 3, continuing the development of the declarative rule-based agent modelling software as a component of the ICT tool box.

8 References

BICKING, M.; Butka, P., Delrio, C., Dunilova, V., Hilovska, K., Kacprzyk, M., Lotzmann, U., Lucznik, K., Mach, M., Moss, S., Nowak, A., Pizzo, C., Rinaldi, V., Roszczynska-Kurasinska, M., Sabol, T., Scherer, S., Schmidt, A., Ventzke, S. and Wimmer, M. A. 2010. "D1.1 Stakeholder Identification and Requirements for Toolbox, Scenario Process and Policy Modelling". Deliverable 1.1, OCOPOMO, 2010.

FIPA 2003. Foundation for Intelligent Physical Agents. http://www.fipa.org/

IEEE 1996. IEEE Standard for Distributed Interactive Simulation -- Communication Services, 1278.2-1995. Institute of Electrical and Electronics Engineers. DOI: 10.1109/IEEESTD.1996.80824

IEEE 1998. IEEE Standard for Distributed Interactive Simulation -- Application Protocols, 1278.1a-1998. Institute of Electrical and Electronics Engineers. DOI: 10.1109/IEEESTD.1998.88572

IEEE 2010. IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) -- Framework and Rules; 1516-2010. Institute of Electrical and Electronics Engineers. DOI: 10.1109/IEEESTD.2010.5553440

JENSEN, H.J. 1998. Self-Organised Criticality -- Emergernt Complex Behavior in Physical and Biological Systems. Cambridge University Press

MACH, M.; M. Bicking, P. Butka, K. Furdik, J. Genci, M. Kacprzyk, R. Meyer, S. Moss, M. Roszczynska, S. Scherer, S. Ventzke, M.A. Wimmer 2010. D2.1 Platform

Architecture and Functional Description of Components. Deliverable 2.1, OCOPOMO, 2010

MOSS, S. 2005. "Sociology and simulation: Statistical and qualitative cross-validation". American Journal of Sociology, vol 110, nr. 4, Jan 2005, pp. 1095-1131

NORTH, M.J; N.T. Collier, and J.R. Vos 2006. "Experiences Creating Three Implementations of the Repast Agent Modeling Toolkit" ACM Transactions on Modeling and Computer Simulation, Vol. 16, Issue 1, pp. 1-25.

OCOPOMO 2009: FP7-ICT-2009.7.3 Grant Agreement for Collaborative Project, "Open Collaboration in Policy Modelling (OCOPOMO)", Annex I: "Description of Work", Grant agreement number 248128. Date of approval: 2009-12-14

POSLAD, S., BUCKLE, P., AND HADINGHAM, R. 2000. The FIPA-OS Agent Platform: Open Source for Open Standards. In Proceedings of the 5th International Conference and Exhibition on the Practical Application of Intelligent Agents and Multi-Agents. Manchester, UK.

PROTÉGÉ 2010. The Protégé Ontology Editor and Knowledge Acquisition System. Stanford Center for Biomedical Informatics Research. http://protege.stanford.edu/

Sorensen, M.H and Urzyczyn, P. 2006, Lectures on the Curry-Howard Isomorphism, Elsevier Science.

WOOLDRIDGE, M. and Jennings, N. R. 1995, "Intelligent Agents - Theory and Practice", Knowledge Engineering Review, Vol 10, No. 2, pp. 115-152.

9 Appendix I: Documents for pilot studies

9.1 Campania

These documents have all been provided by the project partners UNISOB in collaboration with our partners in the Campania Regional Government.

9.1.1 Policy scope document

Policy Scope in Campania Region.

On 11 September 2007 the European Commission approved an Operational Programme for the Campania region in Italy for 2007-2013. This Operational Programme comes under the Convergence objective and has a total budget of 6.9 billion Euros. The financing provided by the European Union under the European Regional Development Fund (ERDF) amounts to some 3.4 billion Euros, representing about 11.8% of Community aid to Italy as part of the cohesion policy for 2007-2013.

The national contribution amounts to 3.4 billion Euros and may partly consist of Community loans granted by the European Investment Bank (EIB) and other loan instruments.

Table 1: Projects granted from the European Regional Development Fund

Priority axis	Name of the axis	Number of projects approved (till 12.06.2010)	Total Cost of Intervention (till 12.06.2010)	Total amount paid at the end of the project (till 12.06.2010)	Total Public Contribution	Use of funds (%) (till 12.06.2010)
1	Environmental sustainability and cultural and tourism appeal	200	261 310 350,5	38 620 133,32	2 025 000 000	12,9
2	Competitiveness of the region's productive economy	11	150 298 338,6	95 332 444	1 215 000 000	12,4
3	Energy	0	0	0	300 000 000	0
4	Accessibility and transport	13	435 692 288	55 067 578	1 200 000 000	36,3
5	Information society	10	22 154 672	0	395 000 000	5,6
6	Urban development and quality of life	17	53 477 354	1 736 9176	1 505 000 000	3,6
7	Technical assistance and cooperation	18	10 734 059	1 239 773	224 795 198	4,8

Sources: Operational Programme 'Campania' European Commission Website, PROGRAMMA OPERATIVO REGIONALE FESR 2007-2013 Website

At the end of 2007, there were 460,245 active companies in Campania, which is 8,89% of active companies operating in Italy. 47,7% are active in the province of Naples (219504), 21.4% in

Salerno (98283), 15.6% in Caserta (71735), 8, 5% and 6.9% respectively in the province of Avellino (39035) and Benevento (31650).[2] Out of all companies 303 447 are defined as sole proprietorship[3].

When it comes to the structure of the third sector there are 228 of organizations per 100.000 inhabitants (213 Associations, 2 Foundations, 4 Social Cooperatives, 9 other forms)[4].

Table 2: Composition for legal form in Campania Region (December 31, 2007)

	Avellino	Benevento	Caserta	Napoli	Salerno	TOTAL in Campania (% of total)
Capital companies (corporations)	4053	2949	7723	46467	10084	67276 (14,6%)
Partnerships	3650	2212	7426	51652	11320	76260 (16,6%)
Sole proprietorship	30600	25919	54458	118553	73917	303447 (65,9%)
Other forms	732	590	2146	6832	2962	13262 (2,9%)

Source: "Servizio Statistica" della Regione Campania Website, ISTAT

Table 3: Sectors of activity in Campania Region (December 31, 2007)

	Industry	Services	Fishing and related services	Agriculture	not classified
Number of companies	102261	272158	333	76702	8791
%	22	59	0	17	2
Number of employee (in k.)	423	1225	nd	83	nd
%	24,4	70,8	nd	4,8	nd

According to surveying collection reported by ISTAT per year 2006, in Campania the median of the distribution of the net incomes of the families is equal to 19.587 Euros, approximately 3.500 less than the national median. The Campania is characterized also for a marked variability of the yields: the index of inequality of Gini, calculated attributing to every individual familiar yield equivalent of the belongings family, is equal to 0,315, the value more elevated in Italy and par to approximately the 5 for hundreds in more of the national average.

Also using pointers of poverties not based on the level of the consumption, the Campania data appears: in 2006 approximately the 24 for 100 of families are declared "to arrive at the end of the month" with strong difficulties, the 41 for 100 are supported not to be able to make forehead to

[2] INFORMATORE STATISTICO CAMPANO, Naples 2008
[3] Servizio Statistica della Regione Campania Website, ISTAT
[4] 8th Censimento dell'industroa e dei servizi, ISTAT, 2001

unexpected expenses of equal entity to approximately 600 Euros and nearly the 80 for 100 had not succeeded to save in the reference year.[5]

9.1.2 Background document on funding

Introduction

The Italian political system is organized not in federal way, but the central Government decides all priorities and funding division fro the Region, Provinces and Municipalities, for example.

So, in Italy we have a National Plan for the European fund, and often the fund request is based on the previous requests (all the system of public expenditure, in the majority of cases work in that way).

So the single Region provides to send a Regional Plan to the central Government, but the Region has to provide a previous agreement with the central Government, and is really more simple if the Government is of the same political party or coalition.

We have again to consider that some Regions have an historical gap with the other region, I think also the Campania region, and so the Region is included in the Convergence objective.

We have also to consider that in Italy the political Parties are very important in the governance of the political system.

Fund certain.

In the case of certain funds, we have to consider that in the majority of the cases, the funds are tied ahead to specific areas or target. You have to consider that also the European funds are bound to specific destinations – as I said in the previous response - such funds for target populations (immigrants, women, disabled, etc..) or for specific territories (such as suburban or mountain communities, municipalities with a population number, etc...).

But in the destination progress you have to consider the stakeholders with specific skills and very closes with political parties (in particular the cooperatives, often politically oriented). They can influence a particular service design suitable to the own curriculum.

The assessor in the specific field can decide the service design, according with the Giunta and the stakeholders potentially involved.

When the notice of the funds distribution arrives, then it starts the comparison and preparation of calls, often with the previous specific agreement. It's the Italian way of lobbying.

So You can consider the presence of an important lack of a specific service, and in Campania Region you have many lacks and needs, as you can see by the research and studies, but in particular in the Analysis prior to the submission of regional project proposals, which also influence the subsequent choices also of the central Government.

Uncertain funds.

For the uncertain funds, the liberty of choice for the Assessors (and the Giunta) is more important and large, but the difficulty for the stakeholders is that this kind of funds can be reprocessed at any moment (I think to the FAS – Fondi Aree Sottosviluppate / Underdeveloped Areas Funds, the top funds, because richer and with less constraints, however, and which is the central government directly to decide with the regions and local authorities).

9.1.3 First story

Intervention:

Public Notice for the development of networks of excellence between Universities, Research Centers and Enterprises

Beneficiary: University-Research Centers-Enterprise

[5] Economie regionali, L'economia della Campania nell'anno 2008, BANCA D'ITALIA, Napoli 2008 (http://www.bancaditalia.it/pubblicazioni/econo/ecore/note/2008/campania/Campania_2008.pdf)

Implementing body: University

Type of subject actuator: University

Lead Institution: University

Title of notice: Public Notice for the development of networks of excellence between Universities, Research Centres and Enterprises

attached: Bando_documentazione.zip

Link: - http://www.fse.regione.campania.it/

- http:// www.regione.campania.it/

Deadline: 15/01/2010

Place of the activity / project: regional territory

Description of the Notice:

The notice concerning projects for the development of networks of excellence between Universities, Research Centres and Enterprises. The establishment of regional networks / clusters may represent an adequate solution for the promotion of research, technological development and innovation by focusing - on the one hand – on the promotion of territorial excellences and – on the other – on the processing of knowledge and experience acquired in new solutions. In this context, cohesion policy can help the region to build up research capacity and innovation, stimulate and support innovations in the social and exchange best practices in transnational cooperation and interregional cooperation. The research, the technological development and the innovation, promote the knowledge economy, promoting growth and employment. The notice is aimed at partnerships already established or being set up, at least composed of three types of partners: University based in Campania, Research Centres located in Campania and Enterprise with head office and / or business in Campania. Each project will be divided by providing three lines of action, highly integrated and complementary. Action Line 1: Research. Action Line 2: training activities. Action Line 3: activities of dissemination of results. The project must have a minimum duration of two years and will be completed by December 31, 2013. The financial resources available for the development of networks of excellence between Universities - Research Centres - Enterprises amounted to € 49,428,000.00, to rely on Axes IV and V of the ESF POR Campania 2007-2013.

Expiration Date: December 15, 2010.

Actions directed to: University-Research Centers-Enterprise

Axes:

IV - Human Capital

V - transnationality and interregionality

Specific Goals:

l) networking among Universities, technological centres of research, institutional and productive world with particular attention to promoting research and innovation.

m) promote the establishment and development of initiatives and networks for an interregional and transnational cooperation, with particular focus on exchange of best practices.

Operational objectives:

l2) support the development of networks between Universities, research centres and enterprises;

l4) support the orientation of young people in research and science.

m1) support national and transnational mobility for academic research and also develop solidarity and awareness of European citizenship;

m2) improving the training, including apprenticeship, in contexts outside the territory of Campania;

m3) strengthening national and international networks between Research Centres and networks for technology transfer, for the exchange of good practices;

m4) to implement initiatives for the return of talent in Campania Italians abroad;

m5) to strengthen the integrated training with outside the region;

m6) to improve penetration of Campanian companies in international markets through the formation of specialized figures;

That's the Call

A.G.C[6]. 06 - Scientific Research, Statistics, and Computer Information Systems – Sector of the Scientific Research, Statistics, Management Control and Project Advancement – Managerial Decree n. 414, November 13, 2009 - POR Campania 2007/2013 ESF: Priority IV - Human Capital, specific objectives l) Axis V-transnationality and interregionality, specific objectives: m) approval of Public Notice for the development of networks of excellence among Universities - Research Centres - Enterprises with attachments: PUBLIC NOTICE: developing networks of excellence among Universities' - Research Centres - Enterprises (A) APPLICATION FORM (B): FORM

How to get to this point?

Constraints of the law:

Article 32, paragraph 1, the general regulation 1083 of July 11, 2006: "The activities of the Funds in the Member States shall take the form of Operational Programmes under the National Strategic Reference Framework".

That is the general lines are established at national level.

The ways to push favorably programming are:

Lobbying at political partylevel, that is to seek mediation through consultation inside the party (sometime the collusion), especially if the local party is the same ruling party or government or is in the same coalition.

The counseling agencies have a considerable weight, because often provide expert staff at both the political and administrative tasks, the task of ensuring the preparation of drafts, if not the documents themselves.

The Conference "State - Regions - Local Governments", under Article. 8, paragraph 6, of Law 131/2003 shall prepare (in this case did so on February 3, 2005) the agreement between the parties on the national policy document (in this case the "Guidelines for the preparation of the National Strategic Framework for the Cohesion Policy 2007 - 2013").

In fact, *the Conference "State - Regions - Local Governments" under Article. 8, paragraph 6 of Law 131/2003, adopted on 3 February 2005 the agreement on the document "Guidelines for the preparation of national strategic framework for cohesion policy 2007-2013" (the Guidelines), that contains the path to procedural and methodological frame for the definition, in both the national and regional level, a unified strategy for cohesion policy based on EU funds for this purpose both on the national funds deputies, for the purposes of Article. 119 of the Constitution, through the Fund for Underutilized Areas, the institutional arrangements of the Program and the Framework Programme Agreements.*

In this context, the central Government reserves a share of funds that can then be activated on direct consultation and negotiation by each institution potentially beneficial as well as provides for the concentration of funds on certain large projects of national importance and / or particularly urgent, cutting out such a large role in advisory groups or public agencies or companies formed an *ad hoc* (General Contractors).

This logic is then implemented also by the Campania Region, as *the ERDF POR Campania 2007 - 2013, consistent with the provisions of Article. 37 of EC Regulation No 1083/206, Annex 1, contains the indicative list of major projects that will be notified during the planning period under Articles. 39-41 thereof and in the manner provided by Regulation for Implementation No 1828/2006.*

[6] A.G.C. Area Generale di Coordinamento (General Area of Coordination).

That is, the Region reserves the right to complete ongoing communication of selected major projects, while maintaining a level of discretion, where it can open a space for consultation and bargaining on the part of potential beneficiaries, in the same way the central government.

Indeed, *implementing the principle of concentration, the Campania Regional Operational Programme 2007-2013 ERDF provides that 40% of available resources is allocated to large projects.*

The Regional Giunta with Resolution No. 26 of 11 January 2008 has done so to allocate the total budget for each operational objective of the Program and to grant the General Areas of Coordination functions related to the management and control of operations on the basis of their competence as established by Law 11 / 91.

The General Areas of Coordination are appointed to support the structures of individual Assessor, who are often accompanied by staff for coordination and joint programming and planning.

By Decree of the President of the Giunta No 62, March 7, 2008 and following modifications have been designated as responsible for operational objectives of the ERDF POR Campania 2007-2013, Directors pro tempore of the relevant regional areas, which build the organizational structure in which they are institutionally hinged.

That is, coming European Programming due to the mandate of the *Giunta*, the appointment is *pro tempore*, pending the appointment of new coordinators and managers by the new Executive.

The Regional Council, with Resolution No. 326, March 6, 2009, approved the procedure for submitting applications for funding for major projects under the ERDF POR Campania 2007-2013 and for the identification of new major projects.

Finally, the proposal of the National Strategic Framework (NSF) has been approved in the Joint Conference State-Regions with *the agreement of 21 December 2006 and by the CIPE*[7]*, at its meeting on December 22, 2006, and was sent to the European Commission for the next phase of confrontation.*

These are opportunities for consultation and mediation between the various stakeholders in the planning.

At this point, *based on informal negotiations conducted with the European Commission, have made changes and additions to the NSF, whose final version was submitted to the Commission March 3, 2007*.

Even with the European Commission will proceed through negotiation, albeit informally.

All these underlined indications can be found in official documents (resolutions), which accompany and prepare the proper notices.

[7] The Interministerial Committee for Economic Programming (CIPE) is a collegiate body of the government chaired by the Prime Minister and composed of the Economic Ministers: The Committee is chaired by the Prime Minister and consists of 13 permanent members: the Minister of Economy and Finance (Vice President), Minister of Foreign Affairs, the Minister of Economic Development, the Minister for Infrastructure and transport, the Minister of Labour and Social Policy, Minister for Agriculture and Forestry, the Minister of Environment and protection of land and sea, the Minister for Culture and Heritage, Minister for Education, Universities and Research, Minister for European Policy, the Minister for Relations with the Regions, Minister for Tourism, the President of the Conference of Presidents of Regions and Autonomous Provinces, Secretary of CIPE is the Secretary to the Prime Ministers. Attending meetings of the Committee: Secretary to the Prime Minister, the Governor of the Bank of Italy, the President of ISTAT. At the invitation of President may be called upon to sit on the CIPE also: Ministers outside the CIPE whose skills are included in the area of the proposal on the agenda, leaders of state institutions and authorities on the subjects to agenda, representatives of regions and provinces, where, for example, are the agenda topics related to infrastructure work required by law 443/2001 (so-called objective law), the Secretary General of the Presidency of the Council of Ministers.

At regional level, meanwhile, *the Campania Region, with Resolution No. 1042 of 1 August 2006, adopted the "Regional Strategic Document for Cohesion Policy 2007-2013", based on indications of the Regional Council expressed its meeting on July 18, 2006 and referred to the strategic DGR*[8] *1809/05*.

Of course they are all acts of political direction, which weighs heavily on the influence of parties and stakeholders of reference of individual parties, as well as public ones, like other local government, primarily the large cities, provinces and other entities (Asl[9], Universities, Trade Unions, SMEs, Industrial, etc...)

Thus, the region of Campania, *with Resolution No. 453 of 16 March 2007, closed the consultation phase, approved all proposals for operational programs*.

Then, the Campania Region with *Resolution No. 2 of 11 January 2008 noted that the European Commission with Decision No C (2007) 5478 of 7 November 2007 adopted the Campania Regional ESF Operational Programme 2007-2013*.

Finally, the Campania Region with *Resolution No. 27 of 11 January 2008 noted that the Programme's budget is allocated for each operational objective*.

Social ties:

Important consideration of local situations, just think of the importance of large municipalities, the provincial capitals and large cities with high population density. Extremely strong weight of Naples, where it's also established the regional headquarters and many more important, than the large and historical universities, and the large concentrations of interest and capitals.

The statistics continue to talk about a disconnect between the various parts of the territory and we must always consider the very high rate of unemployment, poor services and poor quality of life, with a high crime rate and widespread illegality.

The most important gap for the Campania is a lack of infrastructure, stable job and regular high school dropout and lowest percentage of graduates Compared to the rest of Italy, expecially to the northern regions.

The electoral basins impact much on the choices of the Regional Government, as well as personal advisers of candidates which may affect very heavily on scenarios.

Strategic sectors can change very quickly, except structural ones.

For example, it is sufficient to see the revocation of the invitation for Local Training Agreement by the new administration, despite the start of procedures, that is with the call procedures in progress, revocation done for the overshoot of the Stability Pact.

The continuous political changes locally, also considering the different scanning of the election for the various levels, also leads to instability and lack of continuity of action.

The diversity of managers also leads to lack of preparation of the offices, often deprived of authority by the advisor of the Assessor and the parties, with the consideration of a difficulty in knowing how to spend and to complete projects. The data of the loss of European funds is quite clear about that.

But what is the procedure?

The case of the notice of networks of excellence is quite illustrative. To enable the effective implementation of that notice, the Region distrusts the universities of the region to act as leader. So a number of strategic areas are identified, consistent with the axes of programming. Great private research centres are lacking indeed in the territory, in some areas, while others are still public. Italy in general suffers from years of a policy of penalty, in times of crisis, of the research area, and even large groups often are born and grow in a position of public protection (aid, grants, etc.). Of course with European standards this is no longer possible, if not for strategic domains.

[8] Delibera di Giunta Regionale: Deliberation of the Regional *Giunta*.
[9] Azienda Sanitaria Locale: Local Health Unit/Agency.

Specifically for the notice, before its release will convene a table with potential stakeholders, seeking to reach agreement, so as not to disperse the funds.

Table 1: Goals and issues

Thematic Networks

Health Biotechnology: Health - Biotechnology

Agrifood Environment: Environmental control, sustainable construction, earth observation, sustainable development, food, livestock sector, etc..

Enabling Technologies: Information and Communications Technology (ICT) - materials and production.

Industrial Technologies: Energy - Transport - Aviation - Space

Socio-economic sciences, humanities, cultural heritage, tourism: Socio-economic sciences - humanities - cultural heritage - tourism

The identification of networks was done assessing the characterizations of the individual universities. That the seven Campanian Universities, all forced to face the decline in public transfers, have agreed to targeted partnering with each time a university with the curriculum more relevant to serve as leader. Naturally, between the Universities the most important part has held by the largest and most important of the Universities, "Federico II", but were called to the table all the universities, then distributed to individual tables, one for each network to be established. To overcome the preponderance of the University "Federico II", the other universities have managed to provide that an individual one cannot participates in more than three networks.

Each university has brought to the table inherited partnering and each had naturally research centres already partner or trust, as well as companies or enterprises.

The table was done in constant dialogue with the Region and has come so at the closure of the contract and at the award of contract for this partnerships.

The obligation of co-ordination by the University was specifically requested in the notice.

Article 3 Beneficiaries of the Notice

This notice is aimed at partnerships already established or being set up, at least composed of three types of partners: University based in Campania, Research centres located in Campania and enterprises with headquarters and / or business in Campania.

To strengthen the partnership was also planned sharing of foreign partners.

It is hoped the strong partnership within the same partnership of more universities. To complement the partnership must be provided a requirement for a foreign partner of excellence with a partner network, represented by a University or a Research centre.

The partnership will find inside the University as the institution leading the project which will be the contact institution for the Campania Region.

Each institution, individually or in association, may participate up to three projects for each network.

9.1.4 More information for first story

Action Line 1: research activities;

Action Line 2: training activities;

Action Line 3: activities to disseminate the results.

As part of action line 1 (research) can be identified, as example, the following activities:

1.1. fellowships to support the joint research project;

- grants for technology transfer / fellowships / research grants for postgraduate

- **recipients:** Graduates unemployed / unemployed born and / or resident in Campania.

- fellowships / research grants for starter researcher / postdoctoral
  - **recipients**: individuals born and / or resident in Campania with PhD or experienced in research with at least 5 years of documented experience (grants, contracts ...). Are excluded: holders of permanent employment contract, contract holders fixed assets for teaching and / or research, institutional and / or supplementary, with annual gross of more than EUR 10,000.00, recipients of PhD scholarships, postdoctoral and / or scholarships, fellowships, holders of individual income exceeding EUR 30,000.00 gross per annum (the limit of annual report 2008).
- scholarship / research grants for senior researcher
  - **recipients**: researchers who have at least 7 years experience, born and / or resident in Campania. Excludes: holders of permanent employment contract, holders of fixed-term contract for educational activity and / or research, institutional and / or supplementary, with annual gross of more than EUR 10,000.00, beneficiaries of grants doctoral, postdoctoral and / or scholarships, fellowships, holders of individual incomes exceeding 30,000.00 euros gross per annum (the limit of annual report 2008).

1.2. grants to fund national / international mobility projects for researcher;

- mobility grants
  - **recipients**: researchers living in Campania Region or working with fixed-term contracts with research institutions based in Campania.

1.3. grants and contracts to share knowledge search tools with the ultimate goal of becoming part of networks of supra regional level;

- mobility grants
  - **recipients**: researchers living in Campania Region or working with fixed-term contracts with research institutions based in Campania.

1.4. grants to fund research activities to be carried out in Campania by residents abroad excellence.

- grant / contract for the researcher
  - **recipients**: without limitation.

As part of action line 2 (training) can be identified, as example, the following activities:

2.1. postgraduate training courses (PhD, post doctoral, internship, master, vocational modules ...);

- PhD scholarship for three years
  - **recipients**: graduates unemployed / unemployed residents in the Campania Region.

2.2. grants to fund national / international mobility projects for youth undergraduate and graduate students;

- mobility grants to join in mobility projects promoted / recognized by the European Commission and from the MFA (es. Erasmus/Erasmsus Mundus - Socrates - Leonardo….)
  - **recipients**: undergraduates / graduates of universities located in Campania.

2.3. grants / contracts for inclusion in the integrated training chain (internships, master, conferences) of excellences from outside the region;

- grants and contracts for human resources of high profile
  - **recipients**: without limitation.

2.4. assistance for the training of specialized figures in the activities of penetration of Campiania companies in domestic and international markets (internship - Master - mobility grants - on job training - voucher)

- Stage, master, mobility grants, training on job, voucher

- **recipients**: Residents and / or born in Campania.

2.5. training courses for management executives;

- Stage, master, mobility grants, training on job, voucher
  - **recipients**: Residents and / or born in Campania.

2.6. training requirements of employees of the joint functional operational partners (Reg 800/2008 Art. 39) / mobility interventions

- Intervention to update / improvement / upgrading / skills / stage / personalized accompaniment (coaching) to meet and exchange interventions aimed at supporting transnational mobility
  - **recipients:** entrepreneurs and employees of companies operating partner of the partnership working at offices in Campania.

As part of action line 3 (dissemination) can be identified, as example, the following activities:

3.1. grants / contracts for the dissemination of research results;

- grants for technology transfer / fellowships / research grants for postgraduate
  - **recipients:** Graduates unemployed / unemployed born and / or resident in Campania.
- fellowships / research grants for starter researcher / postdoctoral
  - **recipients**: individuals born and / or resident in Campania with PhD or experienced in research with at least 5 years of documented experience (grants, contracts ...). Are excluded: holders of permanent employment contract, contract holders fixed assets for teaching and / or research, institutional and / or supplementary, with annual gross of more than EUR 10,000.00, recipients of PhD scholarships, postdoctoral and / or scholarships, fellowships, holders of individual income exceeding EUR 30,000.00 gross per annum (the limit of annual report 2008).
- scholarship / research grants for senior researcher
  - **recipients**: researchers who have at least 7 years experience, born and / or resident in Campania. Excludes: holders of permanent employment contract, holders of fixed-term contract for educational activity and / or research, institutional and / or supplementary, with annual gross of more than EUR 10,000.00, beneficiaries of grants doctoral, postdoctoral and / or scholarships, fellowships, holders of individual incomes exceeding 30,000.00 euros gross per annum (the limit of annual report 2008).

3.2. grants and contracts to carry out projects aimed at achieving technology transfer (training on job).

- grants for technology transfer / fellowships / research grants for postgraduate
  - **recipients:** Graduates unemployed / unemployed born and / or resident in Campania.
- fellowships / research grants for starter researcher / postdoctoral
  - **recipients**: individuals born and / or resident in Campania with PhD or experienced in research with at least 5 years of documented experience (grants, contracts ...). Are excluded: holders of permanent employment contract, contract holders fixed assets for teaching and / or research, institutional and / or supplementary, with annual gross of more than EUR 10,000.00, recipients of PhD scholarships, postdoctoral and / or scholarships, fellowships, holders of individual income exceeding EUR 30,000.00 gross per annum (the limit of annual report 2008).
- scholarship / research grants for senior researcher
  - **recipients**: researchers who have at least 7 years experience, born and / or resident in Campania. Excludes: holders of permanent employment contract, holders of fixed-term contract for educational activity and / or research, institutional and / or supplementary, with annual gross of more than EUR 10,000.00, beneficiaries of grants doctoral, postdoctoral and / or scholarships,

fellowships, holders of individual incomes exceeding 30,000.00 euros gross per annum (the limit of annual report 2008).

In Campania there are important Centres of competence, which have precisely the task of promoting agreements between Universities, Research Centres and Companies to transfer knowledge and skills. They are particularly active in the fields of science and technology.

Thematic Networks

Health Biotechnology: Health - Biotechnology

Skills List

Health:

Regional Centre of Competence on Molecular Diagnostics and Pharmaceuticals:

Organization:

Institute for Biostructures and Bioimaging - Consiglio Nazionale delle Ricerche (CNR) -National Research Council – Naples (leader)

C.S.I.A.S. (Centro Servizi Interuniversitario di Analisi Strumentale - Interuniversity Services Centre for Instrumental Analysis) - University of Naples "Federico II"

Department of Pharmaceutical Sciences - University of Salerno

Department of Neurological Sciences - Second University of Naples

Department of Experimental Oncology - Istituto Nazionale Tumori (National Cancer Institute) - "G. Pascale" Foundation

Department of Functional and Biomorphologic - University of Napoli "Federico II"

Biotechnology

Regional Centre of Competence BioTekNet is constitued by:

10 Departments of 3 Universities:

Second University of Naples (leader) :

Department of Experimental Medicine

Department of Environmental Sciences

Department of Corporate Strategy and Quantitative Methods

University of Naples "Federico II":

Department of Chemistry

Department of Biological Chemistry

Department of Organic Chemistry and Biochemistry

Department of General and Environmental Physiology

Department of Genetics, General and Molecular Biology

Department of Chemical Engineering

University of Sannio:

Department of Biological and Environmental Sciences

2 Institutes of Consiglio Nazionale delle Ricerche – *CNR -National Research Council*:

Institute of Biochemistry of Proteins

Institute of Biomolecular Chemistry

2 Structures of Hospital Research:

Hospital“Antonio Cardarelli”:

- Service Center for Research and Technological Information

(National Cancer Institute) “G. Pascale”:

Department of Experimental Oncology

2 Parchi Scientifici e Tecnologici:

Consortium Technapoli – *Scientific and technological park of the metropolitan area of Naples and Caserta*

Scientific and technological park of Salerno and Internal Areas of Campania

No Public:

Biogem

Agrifood Environment:

Environmental control, sustainable construction, earth observation, sustainable development, food, livestock sector, etc..

Skills List

Agrifood:

ProdAl Scarl was born from the evolution of the Regional Centre of Competence on Agri-Food Productions, developed in the framework of the funding action 3.16 of POR Campania 2000–2006.

At present ProdAl partners are:

- University of Salerno
- University of Naples “Federico II”
- Second University of Naples
- University of Napoli “Parthenope”
- University of Sannio
- National Research Council
- Experimental Station for Food Preservation Industry – Angri.

Enviromental control:

AMRA, Center of Competence in the field of Analysis and Monitoring of Environmental Risk, is a permanent research enterprise developping innovative methodologies for environmental problems

Partners:

University of Naples Federico II

Second University of Naples

University of Salerno

University of Naples “Parthenope”

University of Sannio

National Research Council (CNR)

National Institute of Geophysics and Vulcanology (INGV)

Zoological Station Anton Dohrn

Enabling Technologies:

Information and Communications Technology (ICT) - materials and production.

Skills List

CeRICT (The "**Regional Centre on Information Communication Technology CeRICT scrl**" is a company that acts in Information and Communication Technology (ICT) domain, with particular focus on the applied research projects. CeRICT headquarter is placed in Benevento, town located in the middle of the **Campania Region**:

The following structures are associates in CeRICT Scrl:

University of Salerno, University Parthenope of Naples, University Federico II of Naples, University of Sannio, Second University of Naples, National Interuniversity Consortium of Informatics, CNR (National Research Conseil) and Pascale Foundation.

Industrial Technologies:

Energy –

Transport

Skills List:

Aerospace

The aeronautic manufacturing weaving has a main role in the economic system of the Campania region. It is a developing territory element in terms of industrial presence and of the high content of the technological know-how requested by the manufacturing processes. Campania represents a national pole for the aerospace cluster, one of the main allocated in Italy (beyond Lombardia, Lazio, Puglia), characterized by a key historical experience of the field industrial operators and the local presence of big national leader companies with a significant international exposure: Alenia Aeronautica, Avio, Europea Microfusioni Aerospaziali (EMA), Magnaghi Aeronautica, Selex Sistemi Integrati), Ilmas, Geven and Dema. There are other companies capable to produce a high valuable and qualified finished product as Vulcanair (P68, A-Viator), Tecnam (P2006T, P2002 JR), Oma Sud (Skycar).

Campania region presents in the aerospace sector an important economic and manufacturing structure highly rooted in the territory. It's one of the few high-tech clusters of the regions Objective I of the European Union. Campania is the region where, in terms of turnover and manufacturing units, the aeronautic sector is manly present. In this Competition Centre you have: C.I.R.A. Centro Italiano Ricerche Aerospaziali - Capua (Caserta) Italian Centre for Aerospatial Research is the Centre of Excellence of the Aerospatial in Italy; CONSAER, Consorzio per lo sviluppo delle aziende aeronautiche (Consortium for the development of aviation companies); MARS; Consortium Technapoli; TEST (è una società consortile, operante il Centro Regionale di Competenza Trasporti - TEST is a consortium, which operates the Regional Competence Center Transport).

No public: You have a list here:

http://www.campaniaerospace.it/index.php?option=com_docman&task=doc_download&gid=793

Socio-economic sciences,

humanities,

cultural heritage,

tourism:

Skills List:

Benecon is one of the ten Research Centres endorsed by the Region of Campania, the committee to the University and Scientific Research- Technological Innovation and New Economy-Information Systems and Statistics, for the support and the technological transmitting to the businesses of the innovative know-how.

Financed by the 3.6 POR Campania 2000-2006 Measure, it exhibits an array of 250 researchers belonging to four different universities of the Campania region and to two research centres, and it also flaunts a wealth of scientific equipment worth 9.600 million euro.

The subject actuators are departments, faculties, research centers, participants on the project and represent also the subjects with juridical responsibility.

Design Knowledge Department - Second University of Napoli

Department of Configuration and Actuation of the Architecture - University of Naples Federico II

Department of Sciences of Education - University of Salerno

Department of Civil Ingeneer - Second University of Napoli

Surgical Department of Internal Medecine "F. Magrassi e Lanzara" - Second University of Napoli

Fine Arts Faculty - Second University of Napoli

Faculty of Political Studies for European and Mediterranean High Education "Jean Monnet" - Second University of Napoli

Department of Economics and Management - University of Naples Federico II

Department of Geophysics and volcanology - University of Naples Federico II

PE.ME.IS Departiment - University of Sannio

Scientific and technological park of the metropolitan area of Naples and Caserta

European University Center for Cultural Heritage - Ravello

A List of involved stakeholders is here:

http://www.benecon.it/sito%20benecon%20in/struttura/s04.html

Skills List:

Innova:

The CNR - INNOVA Regional Centre of Competence for Development and Transfer of Innovation for Cultural and Environmental Heritage was established on 14 February 2003 to supply technological support and consultancy both to institutions conserving and managing the cultural heritage and to firms involved in heritage conservation, promotion and use.

This aim is pursued through innovation by developing original methods of enquiry and adapting consolidated technology, focusing especially on the non-invasiveness and portability of the techniques proposed, matching sector demand with its techno-scientific skills and infrastructures that are continually undergoing further development.

Participants at the Centre come from all the universities in the region of Campania, from five National Research Council institutes, to which INNOVA is also responsible, the two science parks in the region and the European University Centre for Cultural Heritage (CUEBC). In all, approximately 300 university lecturers and researchers are involved in projects at the Centre.

Partenrs are:

Consiglio Nazionale delle Ricerche - CNR (National Research Conseil) (Leader)

· University of Naples Federico II

· Second University of Napoli

· University of Salerno

· University of Sannio

· University of Naples "Parthenope"

· University of Naples "L'Orientale"

· University "Suor Orsola Benincasa" - Naples

· Technapoli – *Scientific and technological park of the metropolitan area of Naples and Caserta*

· *Scientific and technological park of Salerno and Internal Areas of Campania*

· *European University Center for Cultural Heritage - Ravello*

So You have some geographical areas where you have specific competence:

Salerno:

Health, Environmental control, sustainable construction, sustainable development, food, - Energy - cultural heritage - tourism

Benevento:

Biotechnology - Environmental control, earth observation, sustainable development, Information and Communications Technology (ICT) - materials and production - Energy - Socio-economic sciences

Caserta:

Health - Environmental control, sustainable development, food, Information and Communications Technology (ICT) - materials and production - Aviation – Space - Socio-economic sciences - humanities - cultural heritage - tourism

Avellino (the only provincia without University):

Biotechnology - Environmental control, sustainable construction, sustainable development, food, Energy - cultural heritage - tourism

Napoli:

Health – Biotechnology - Environmental control, sustainable construction, earth observation, sustainable development, food, livestock sector - Information and Communications Technology (ICT) - materials and production - Energy - Transport - Aviation –Socio-economic sciences - humanities - cultural heritage - tourism

For General Communication mission:

Rai (National tv) with a Centre of production in Naples

9.1.5 Second story

Announcement about funding uncertain, although included as a continuation of a first experience well done.

These are the Local Training Pacts, experimental formula followed and assisted by ministerial experts for Regions. Experts and assistance program are funded by the project Focus, a projet included in PON Funds, Objective 1.

Campania, a target region, decided to draw on the experience of these experts.

This new formulation of the Pact could be albe to stimulate employment and training.

First announcement:

04/10/2007 - At a press conference this morning at the palace Saint Lucia, the Regional Assessor for Labour and training presented the results of the project on the Local Training Pacts (Patti Formativi Locali - PFL), promoted in collaboration with Regional Councillor for Agriculture and Productive Activities.

The proposals found eligible are 27 out of 34 received, 25 of which with a score sufficient for funding. The total budget amounted to around 60 million euros, of which 54 are publicly funded, which will produce at full 4500 new job opportunities.

For the preparatory stage, the Campania Region has relied solely on the support and technical assistance from the Ministry of Labor, Project Focus Group[10]

[10] Focus is a three-year project (2004-2007) which falls within the Action System Cluster "Integration between training policies and local development" promoted by the Ministry of Labour and Social Security as part of Pon, Objective 1, Technical Assistance and System Actions. The project represents a concrete response to the need for support and operational services and support of regional and local actors in the implementation of the Integrated Planning Territorial devices, including the promotion of Local Training Pacts. Is aimed at stakeholders in regional planning and territorial regions of Objective

"About a year since the ban - said Assessor - has been allocated almost EUR 11 million for training for the enhancement of social capital and social inclusion, more than 32 million for training and job placement for member companies working in PFL, over 16 million in continuing education. Over 11 000 and 600 beneficiaries, of which almost half for training for job placement. The employment impact of 4,500 new employees is expected.

The 25 PFL eligible for funding include 14 terms of sector (tourism, agro-industry, aerospace, transportation and logistics and distribution, ICT, fashion and jewelry) and 11 territorial pacts (4 in the province of Naples, 2 in the province of Caserta, 2 in the province of Benevento, two interprovincial and 1 in the province of Avellino).

"The Local Training Pacts - reminds the other Assessor - are tools designed to increase the quality of training and encourage the pooling of resources and activities on specific areas and production sectors, preventing fragmentation and accompanying policies of integration and exploitation of local resources".

The first year seems to work:

28/06/2008 - The Regional Council of Campania, on the proposal of Assessor for Agriculture and Productive Activities and the Assessor for Education, Training and Work, approved the decision to fund 25 Local Training Pacts

List of Local Training Pacts: "Paths of Tradition and White Art and Planning in Campania", "Chain of Tourism in Cilento", "food chain", "tourism industry of the province of Salerno", "buffalo Chain","Whow walcoming, hospitality and wellness in the tourism sector in Campania", "Area Nolana"," Society and the knowledge in the Province of Naples – ICT", "Termares - Costa del Vesuvio", "Goldsmith Pole", "Tras.Formazione", "Distribuzione.Form", "Terra di Lavoro", "Fashion

---

1 included Molise, who will be involved in a set of integrated analysis, research, advice, assistance and training.
The Prpject is implemented by temporary consortium consisting of RSO (Subject leader), Instituto Guglielmo Tagliacarne, Retecamere, Polytechnic of Milan and Confindustria Sistemi Formativi.
The operational objectives of the project Focus intends to pursue are:
increase the effective implementation of Integrated Projects for the different stages of life;
make consistent and integrated efforts of Pi (Progettazione Integrata – Integrated Planning) in education, training and active employment policies;
create the framework conditions for the initiation and / or consolidation of Local Training Pacts;
strengthen the role of orientation and integration of the Ministry of Labour and regions within the active labor market policies.
The strategic approach of the project focus is characterized by:
strong regional focus provided by the Action Plan (Intervention Plan) regional, is made by all consulting activities aimed at Integrated Project, both from the activities of guidance, support and assistance for the authorities and the responsible management of the ESF, aimed at the overall coordinating the definition and promotion of Local Training Pacts, and the re-programming of operations for the period.
the immediate lay down, however, is guaranteed through the recovery of information assets existing about integrated planning and the immediate initiation of the intervention in some regions which have special situations of urgency and criticality. The Project consists of 5 principle lines and 2 main project. They are:

5 LINES OF PROJECT:
Research and socio-economic and territorial analysis.
Vocational and training needs analysis.
Attachment to the IP, coalition and promotion of PFL (Patti Formativi Locali).
Creating and management of networks.
Assistance to the Working Group of the Ministry of Labour and Social Security - Directorate General for Policy and Guidance and Training.

2 Main project:
Communication and dissemination of the project.
Direction, coordination, self-monitoring and evaluation.

System", "Ruralia ", "Logistics and Transport", "Employment Industrial Development Areas of the province of Naples", "Pact of Acerra- Arzano-Pomigliano d'Arco", "C.u.o.r.e. - City of Benevento", "Pact of Sarno Valley", "Industry", "Pact Amalfi-Sorrento Coasts", "Chain of Campania Aerospace", "Production, logistics, transport and distribution" and "Development of the Province of Benevento territory".

Overall it is made available 57 million euros to be allocated through calls to the financing of projects for professional development to support the creation of enterprises and self employment for the integration of immigrant workers and improved university training, particularly in high innovation and specialization sectors.

Beneficiaries of support will be schools, companies, bilateral institutions, training and research organizations, employment services, public and private universities, research centers and technology transfer, and finally, recipients of vouchers, scholarships and individual benefits.

All job opportunities and training for the Covenants will be reported on the website of the Region, to ensure, with maximum transparency, updated information accessible to operators and interested young of the Campania region.

"Today we make an investment to boost growth and development focusing on skills and human capital, particularly on young people" says An Assessor.

"To stand up to markets and economies faster and more dynamic, Campania and the South must push on quality and innovation of their local systems. The alliance between schools, universities, government, business and credit system is essential to meet this challenge".

"In line with the main participatory address applied in Europe - said the second Assessor - pacts have become in the Campania region in an innovative test, a place of constant confrontation that has shown the ability to weave training, work and initiatives for economic development. Training for employability in the leading sectors of our economy test the efficiency of best practices such as PFL, unique experience in Italy involving institutions, local and entrepreneurial with public funding and financing from the business sector.

The more than 4,000 training opportunities for many job placement can be a virtuous mechanism to mark a turnaround in the difficult employment landscape of Campania,.

This is the notice:

03/05/2010 - By Decree 102/2010 - published in the Official Gazette No 34/2010 - Second Notice has been approved for testing the Local Training Pacts and the necessary forms for submitting project proposals to PFL. The expiry date is fixed at 12.00 on July 2, 2010.

This is the withdrawal:

19/07/2010 - With Resolution No 542 of 09/07/2010 - to be published on Official Gazette - the junta of the Campania Region withdrew Resolution No. 318, 19/03/2010 acknowledgment of the "Guidelines for the second trial of the Local Training Pacts"" published on BURC No 24 of 29/03/2010.

Therefore Decree Managerial No 137 of 19/07/2010 executive decrees were revoked No 102 of 04.26.2010, published on BURC No 34, 03/05/2010 and n. 112 of 06/05/2010, to amend Annex 1 of "According to public notice and models for the submission of project proposals of the Local Training Pacts".

How to get to this point?

Social ties (are the same of the first story, because many advisers are from Universities, which are also partners in the Local Training Pacts):

Important consideration of local situations, just think of the importance of large municipalities, the provincial capitals and large cities with high population density. Extremely strong weight of Naples, where it also established the regional headquarters and many more important, than the large and historical universities, and the large concentrations of interest and capitals.

The statistics continue to talk about a disconnect between the various parts of the territory and we must always consider the very high rate of unemployment, poor services and poor quality of life, with a high crime rate and widespread illegality.

The most important gap for the Campania is a lack of infrastructure, stable job and regular high school dropout and lowest percentage of graduates Compared to the rest of Italy, especially to the northern regions.

The electoral basins impact much on the choices of the Regional Government, as well as personal advisers of candidates which may affect very heavily on scenarios.

Strategic sectors can change very quickly, except structural ones.

The revocation of the invitation for Local Training Agreement by the new administration, despite the start of procedures, that is with the call procedures in progress, for the slippage of the stability pact is a sign of change attempted by the new administration, which has of course their referents in strategic sectors and its consultants to identify strategic areas where are then allowed Local Training Agreement.

The continuous political changes locally, also considering the different scanning of the election for the various levels, also leads to instability and lack of continuity of action. This time it happens that the political change advises to take time to get the definition of strategic sectors, on the basis of the election basins, different than previous ones. The continuity of action has broken, which was also arrived at the opening of the calls, then deleting the allocation of funds for this activity and for these sectors.

To this must be added, again, the strong heterogeneity of executives that also leads to lack of preparation of the offices, often deprived of authority by the advisor of the Assessor and the parties, with the consideration of a difficulty in knowing how to spend and to complete projects. The data of the loss of European funds is quite clear about that..

But what is the procedure?

The case of the notice of local training agreement is quite clear.

Expert advice is sought to ministerial experts, who undertake the procedure, but are not consulted on the issues and areas, which are increasingly decided through consultation and lobbying action.

Specifically in the case of this notice, before the release of the same the convening of potential stakeholders was done locally, seeking to reach an agreement, so as not to disperse the funds and prevent clashes among the various sectors. The provinces have played an important role as a link, also with the push of consulting societies, which have often acted as a catalyst for action and coordination of proactive actions, especially if lead was a public body, providing acts when ready.

The change of the junta has blocked a process that would be held with executives from past junta and the companies that had already won in a position of advantage, given the complexity of the notice and forms. So it was decided to divert these funds to other projects, which allow targeting companies related to the new Executive

9.1.6 Europe Area Project (web site in English)

http://www.sito.regione.campania.it/internazionalizzazione_crdc/europa/en_index.htm

9.1.7 Answers from domain experts to questions of modelling team (via email)

1. What is the role of the regional competence centres? Do they help universities / enterprises to find the right partners for a particular project? Or do potential clients ask the competence centre for a particular service/technology, which in turn triggers the formation of a consortium to develop the new technology?

The role of the regional competence centres is to reinforce Campania Region capacity for scientific research and technological innovation, all for the purpose of successfully developing its territory. One of the key activities of Campania Region is to develop and combine local initiatives of excellence presenting a high level of research and innovation.. The essential requirements for

this development system are the sustainability and quality of the initiatives, which must be based on a virtuous cross-fertilisation between the worlds of research and business.

As for the relation between centres of competences and clients. Potential customers (companies in the first place, although public bodies such as Museums can also be customer) ask to centres a particular service / technology. Since many SME in Campania can not afford the early stages of development of new technologies, they ask to centres the support services that they cannot develop in house. Centres have plenty of space and facilities to experiment new technologies. The competence centres also support networking among small and medium-sized companies.

2. How exactly does phase 3 work? Will there be a call for proposals, defining what kind of "new and sustainable activities" will be financed? If so, who is issuing this call? How exactly are these activities financed?

The first phase of the deployment of this mechanism has already been completed, with the consolidation of the public research centres, resulting in the establishment of the Regional Competence Centres, which involve all the R&D players in the territory (previous programming period). **The second phase**, regards opportunities to match the supply and demand for innovation generated by businesses and research centres (also previous programming period) in the framework of pilot projects. **The third phase** takes advantage of economic resources and points of scientific and technological excellence to finance new and sustainable activities mainly through a combination of public and private incomes. In the third phase the centre itself looks for potential customers. Indeed we are in the third phase. Also at this stage there are call for proposals funded by the Structural funds but they require the joint participation of clients companies with their own resources and the centres of the competence.

Therefore the calls for proposals that are being issued are based on 50% public funding and 50% private investment of companies.

9.2 Kosice

9.2.1 Analysis of Structural Funds

9.2.1.1 Structural Funds 2007-2013

In 2009, several renewable energy projects were supported from EU SF in Slovakia. Funds were distributed through the two ministries - **Ministry of Environment** and **Ministry of Economy**.

Ministry of Environment has the main scheme called **Operational goal 3.2: Minimalization of impacts of climate change including support of renewable energy.**

Link to official web page (in Slovak):

http://www.opzp.sk/pics/upload/users/admin/File/180509/OPZP-PO3-08-5_Schvalene.pdf

The Ministry of Economy distributed the funds for the renewables through their Operational program: Competition and economical growth. Measure 2.1 - Increasing of energy efficiency on supply and demand side and implementation of progressive technologies in energy production.

Link to official web page (in Slovak):

http://www.opkahr.sk/files/articles/file/zoznam_zazmluvnenych_projektov_2_1_sp.pdf

In 2008, EU funds used for sustainable energy projects were distributed mainly through two operating programs.

(i) OP industry and services – eligible projects were oriented on energy efficiency in industrial processes and buildings, projects of combined heat and power production, RE, regulation and automatisation of heating systems including heat distribution networks. Beneficiaries were mainly private companies.

(ii) OP basic infrastructure was also oriented mainly at private companies. Few projects on community level were also supported.

9.2.1.2 Projects Approved in 2009

SF managed by the Slovak Ministry of Environment

Operational goal 3.2: Minimalization of impacts of climate change including support of renewable energy.

In Kosice Region, two projects have been (1,495 million EUR) supported from the Ministry of Environment (eleven in Slovakia). Total amount of funds allocated was 19,505 million EUR.

RE source: Biomass
Beneficiary: ZŠ Švedlár
Project title: Biomass heating plant for elementary school in Svedlar
Allocated grant: 459 568 EUR

RE source: Solar energy
Beneficiary: Domov dôchodcov a domov sociálnych služieb Košice - Barca
Project title: Installation of solar collectors and isolation of social services house
Allocated grant: 1 035 965 EUR

SF managed by the Slovak Ministry of Economy

Operational program: Competition and economical growth

Measure 2.1 - Increasing of energy efficiency on supply and demand side and implementation of progressive technologies in energy production

In Kosice Region, two projects have been (4,005 million EUR) supported from the Ministry of Economy (23 in Slovakia). Total amount of funds allocated was 57,169 million EUR.

RE source: Small hydro power
Beneficiary: PRAVEL spol. s r.o
Project title: Small hydro power plant Prakovce II
Allocated grant: 1 242 761 EUR

RE source: Solar - photovoltaic
Beneficiary: THERMALTECH s.r.o.
Project title: Solar photovoltaic power plant Malý Kamenec
Allocated grant: 2 761 807 EUR

9.2.2 Energy situation in Slovakia and Kosice region

9.2.2.1 General Stability of Electric Supplies in Slovakia

Slovakia is short of its own primary energy raw material. The country has no black coal deposits; the few crude-oil fields and gas fields being mined can hardly meet a small percentage of the total consumption. The structure of the primary raw material consumption indicates that as little as 7 % of energy demand is covered by the brown coal production, some 4 % of the energy required is generated by water power plants, and almost 2 % of the Slovak energy demand is covered by domestic gas and crude-oil production. All other primary sources of energy have to be imported. Resources with good prospects refer to some alternative ways of energy recovery. In terms of power generation, Slovakia is now among the developed European countries. The present situation results from the actual economic development of Slovakia. The structure of the resources of electric energy generated in the course of the referred-to development seems ideal for the complementarity of all water-driven, thermal-driven, and nuclear-driven mechanisms of power generation. The coexistence of all the three types of power plants allows flexibility and utilisation of the specific assets of different types of electric generating stations, enables flexible system management and reduces dependency on the external conditions, esp. the weather, and on the actual course of trade. The resource structure good for electric power generation seems quite promising. The power generation goes dynamically following all technical, economic, and ecological criteria involved. In terms of the installed generating capacity structure, nearly a third of the power generation falls on the water plants, another third falls on the thermal power stations, and the last third falls on the nuclear power plants.

The electric energy generated in Slovakia in 2004 amounted to 30,543.4 GWh.

The total installed generating capacity fluctuated around 8,160 MWh. Good condition of the technical equipment and good economic parameters enabled almost 12 % of the generated energy to be exported abroad.

In 2004, the nuclear power plants generated as much as 66.57% of the domestic electricity, the hydraulic plants accounted for 15.41%, and the thermal plants for 18.02% of the energy generated for the domestic market. The referred-to data on the electricity generation are given in the table below.

9.2.2.2 KOSICE REGION

The Košice region has its own energy infrastructure. The combined coal-fired and gas-driven power plant of Elektrárne Vojany seems to be the most important energy resource of the region. The plant is situated in the district of Michalovce, and comprises two generating operations: Elektrárne Vojany I (EVO I – 6 x 110 MW) and Elektrárne Vojany II (EVO II – 6 x 110 MW).

In Košice region important are also water power plants, small water power plants and cogeneration units with internal combustion engines to natural gas.

PARAMETRES OF POWER PLANTS

Table 1: Parameters of Elektrárne Vojany power plant (coal/gas)

	EVO I	EVO II
generating capacity	660.00 (6x110) MW	660.00 (6x110) MW
block count	6	6
fuel	Black coal	Natural gas, mazut
introduction into service	Blocks 1–4 /1966 blocks 5-6 / 2001	1973–1974

Table 2: Parameters of Dobsina and Ruzin water power plants in Kosice Region

	Dobšiná	Ružín
category	24; 2	60; 1,8
generating capacity	6	6
flow	Hnilec; Dobšinský Potok	Hornád
introduction into service	1953; 1994	1972

Table 3: Parameters of small water power plants in Kosice Region

No	Locality	Water flow	Voltage levels	Generating capacity (kW)
1	Košice	vodojem TO	NN	132
2	Košice	vodojem RI	VN	75
3	Košice	vodojem T2	VN	132
4	Vojany	okruh chladenia	VN	495
5	Spišské Vlachy	Žemrica	NN	26

6	Čierna Lehota	Štítnica	NN	44
7	Nižná Rybnica	Okna	NN	30
8	Stará Voda	Hnilec	NN	75
9	Jaklovce	Kojšovský potok	NN	8
10	Drnava	Čremošná	NN	41
11	Mokrá Lúka	Muráň	NN	30
12	Gočovo	Slaná	NN	70
13	Gelnica	Hnilec	NN	180
14	Sečovská Polianka	Topľa	VN	75
15	Košice	Hornád	VN	660
16	Košice	Myslavský potok	NN	18
17	Ruskovce	Okna	NN	7,5
18	Spišské Bystré	vodojem	VN	110
19	Krompachy	Hornád	VN	110
20	Nálepkovo	Hnilec	NN	70
21	Rožňava	Slaná	VN	260
22	Plešivec	Slaná	VN	270
23	Mníšek nad Hnilcom	Hnilec	VN	150
24	Gelnica	Hnilec	NN	105
25	Gelnica	Hnilec	NN	105
26	Slavošovce	Slaná	NN	22
27	Veľký Folkmar	Kojšovský potok	NN	15
28	Bukovec	vodná nádrž	VN	37
29	Košice	Hornád	VN	400
30	Družst. pri Hornáde	Hornád	NN	800
31	Vidová	Slaná	VN	640
Total generating capacity (MW)				5,193

Table 4: Parameters of cogeneration units

Locality	**Type of generator**	**Voltage levels**	**Generating capacity**
Spišská Nová Ves	synchronous	NN	400
Spišská Nová Ves	synchronous	NN	150

Moldava nad Bodvou	synchronous	VN	400
Prakovce	synchronous	VN	390
Prakovce	combustion engine	NN	308
Trebišov	combustion engine	VN	150
Total generating capacity (MW)			1,8

Resources of Geothermal Energy in Kosice Region

The geothermal energy affords vast opportunities for power generation, and house heating having thus a great impact on the development of power industry, local spa management, and land management.

The territory of the Košice region is, compared to other regions in this country, rather rich in geothermal resources. Following its outcome, the geological prospecting has singled out the following three areas in the region as those having good prospects for use in the future:

- Košice Valley (the estimated energy potential of 1,200 MW)
- Mountain range of Humenský chrbát (800 MW)
- Area of Beša-Čičarovce (200 MW)

Speaking of potential, the best prospects go to the Košice Valley, which is noted for the occurrence of geothermal underground waters of the temperature ranging from 120°C to 160°C (over 3,000 meters in depth). The prospecting for crude oil carried out on a systematic basis in the East Slovak Basin has brought about some information on the occurrence of mineralised oil-field water of the increased level of iodide. These are tepid or hot waters of curative effects good for bathing, swimming and drinking. The wells of the highest iodine levels are found in the areas of Kecerovské Pekľany, Čičarovce, Senné, Ptrukše, Trhovište, and Stretava. The total energy potential of the available resources, incl. low-temperature (around 30°C) waters, is estimated at 3,500 MW of the thermal output. The potential of the geothermal 75°–95°C water accounts for 500–600 MW. The efforts made so far with the view of the future geo-energy utilisation include development of several feasibility studies and specific project designs for the locations of Olšavská dolina (Olšava Valley) and Zemplínska Šírava. Some other in-process projects refer to the geothermal resources found in the south of the East Slovakia lowlands.

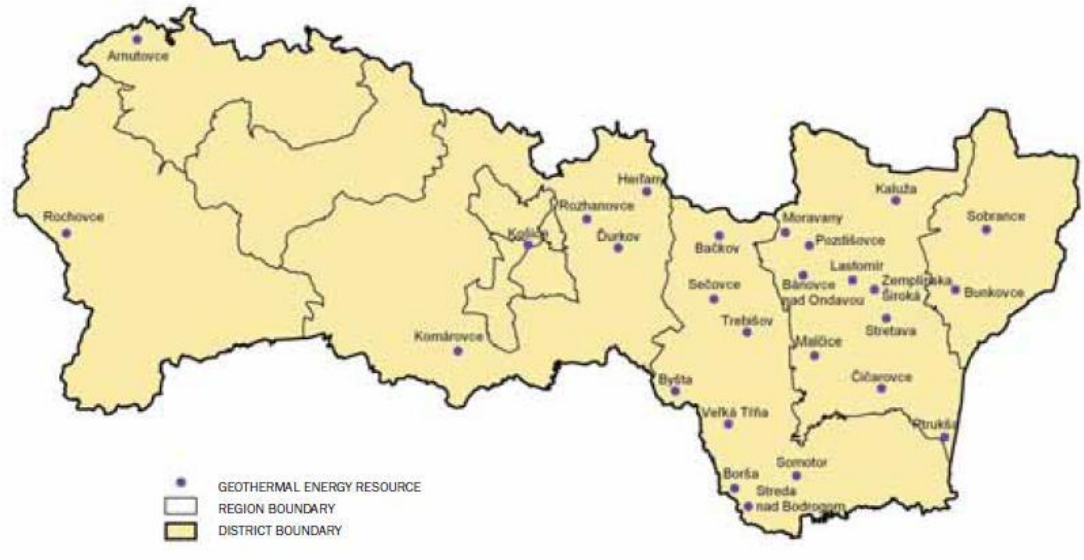


Figure 18: Resources of geothermal energy in Kosice Region (2004)

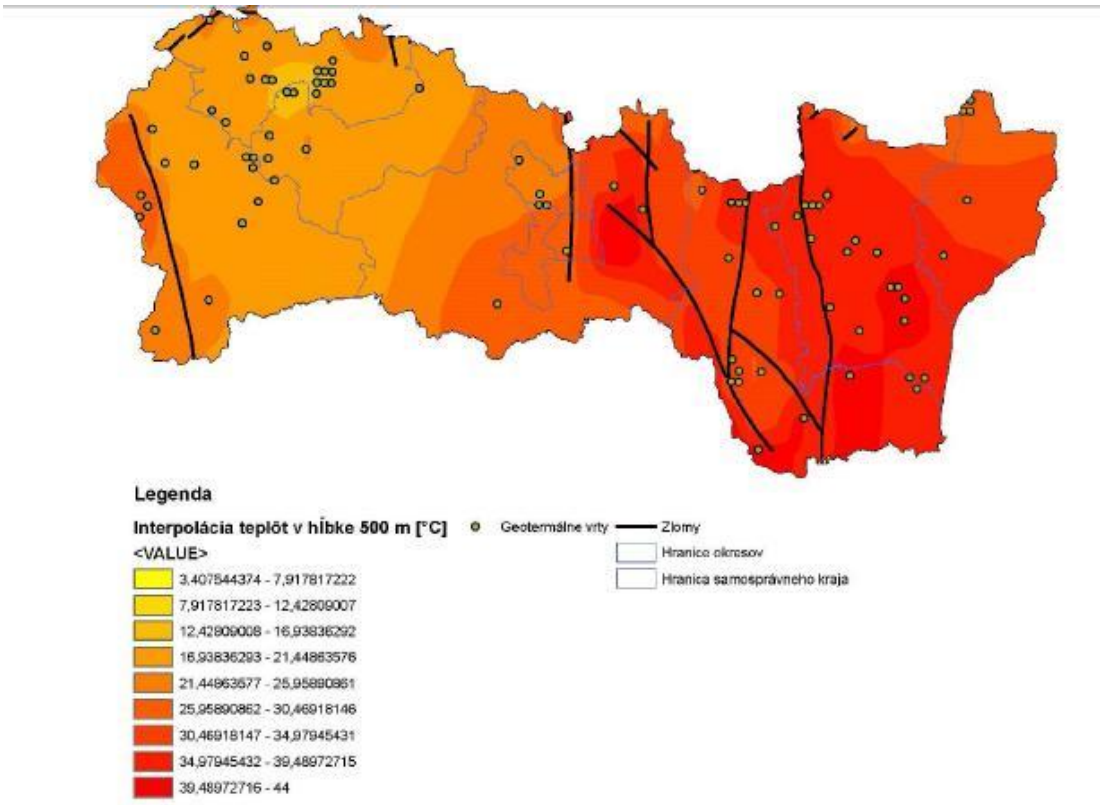


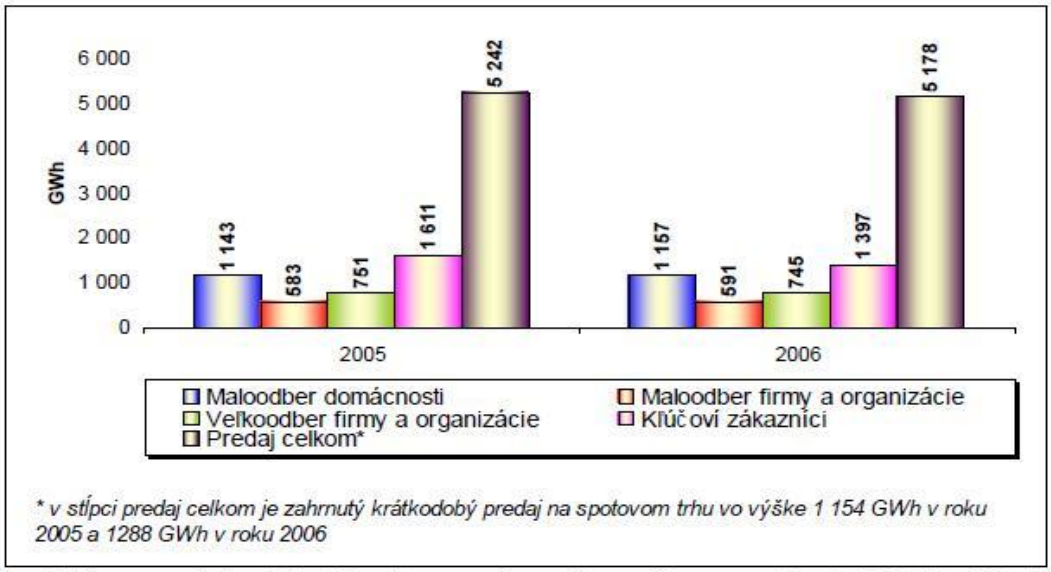
Figure 19: Geothermal energy potential in the Kosice region

Energy Receivers in Kosice Region

Table 5 Characterisation of energy consumers in Kosice Region

Category	2005	2006

Household	MOD	1143 GWh	1157 GWh
Small companies and organizations	MOP	583 GWh	591 GWh
Big companies and organizations	VO	751 GWh	745 GWh
Key Customers	KA	1611 GWh	1397 GWh
TOTAL		4088 GWh	3890 GWh



Štruktúra predaja elektriny koncovým zákazníkom v rokoch 2005 a 2006

Figure 20: Structure of energy consumers in Kosice Region

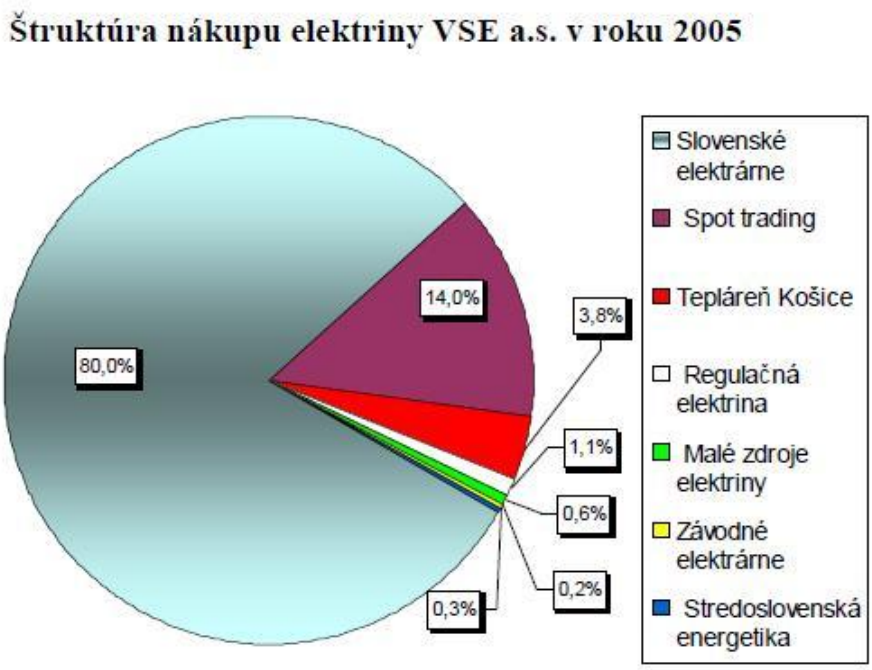


Figure 21: Structure of electricity purchase in Kosice Region

Translation of legend in Figure 21:

Slovenské elektrárne - Slovak Power Plants
Spot trading - Spot trading
Tepláreň Košice - Tepláreň Košice
Regulačná elektrina - Regulatory electricity
Malé zdroje elektriny - Small sources of electricity
Závodné elektrárne - Power Racing
Stredoslovenská energetika - The Central Energy

Potential of renewable energy

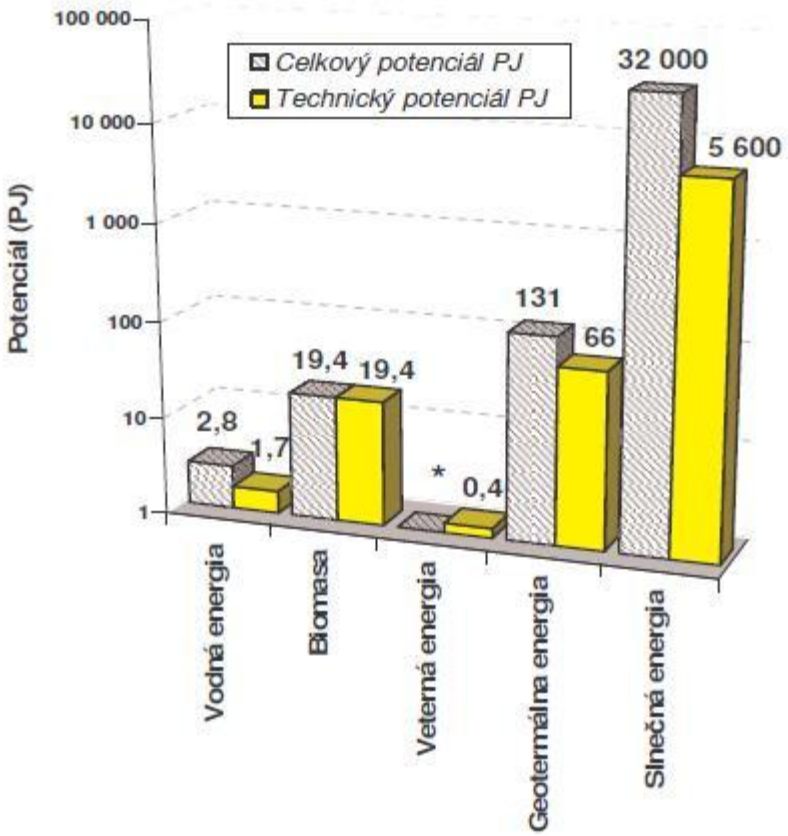


Figure 22: General and technical potential of renewable energy

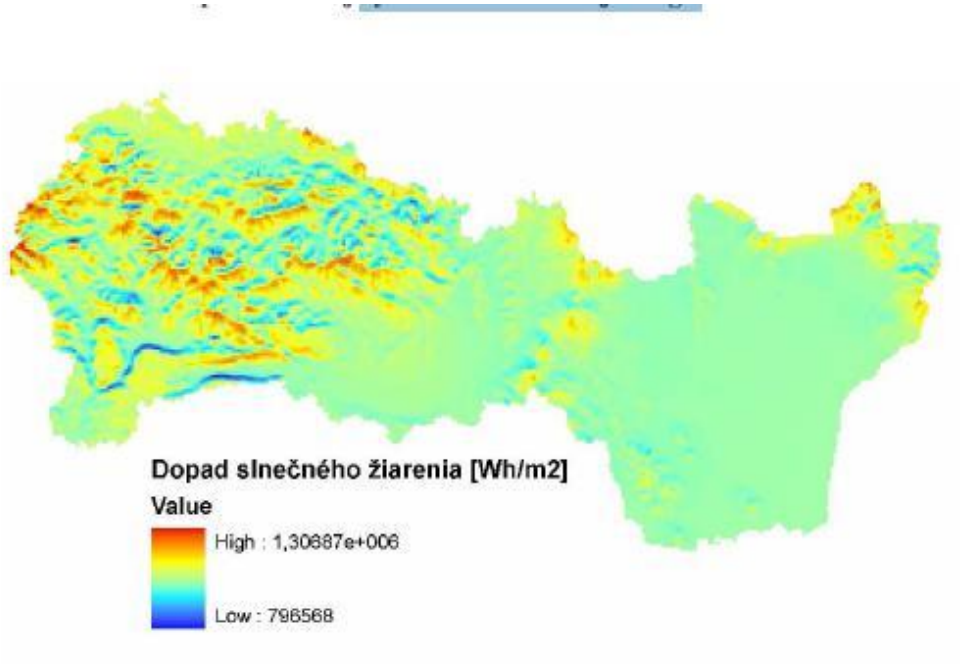


Figure 23: Technical usability of solar energy

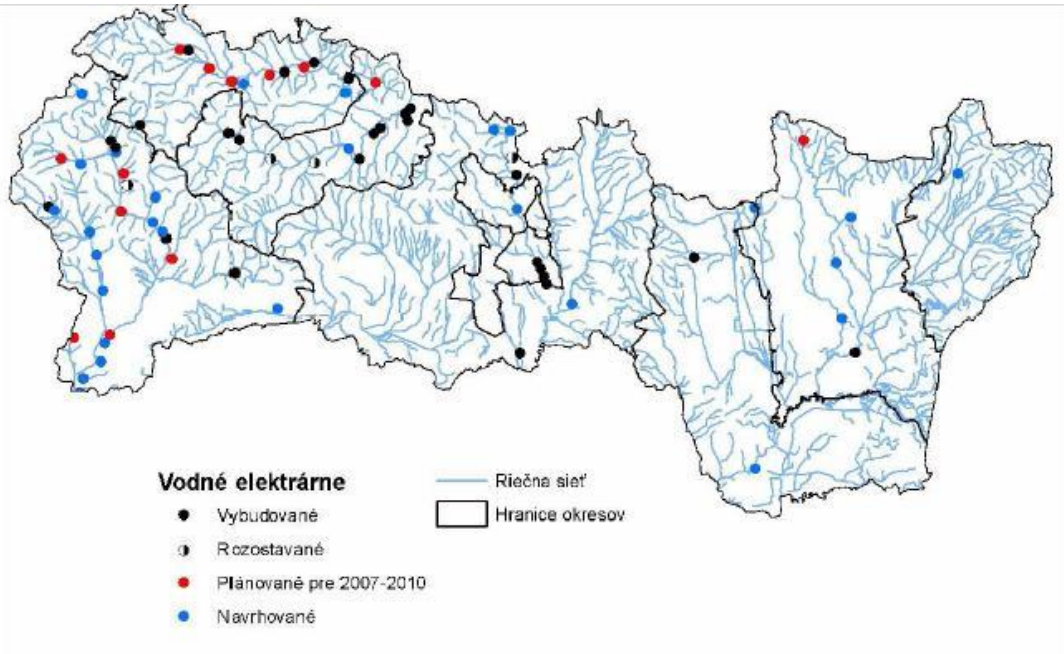


Figure 24: Utilization of water energy

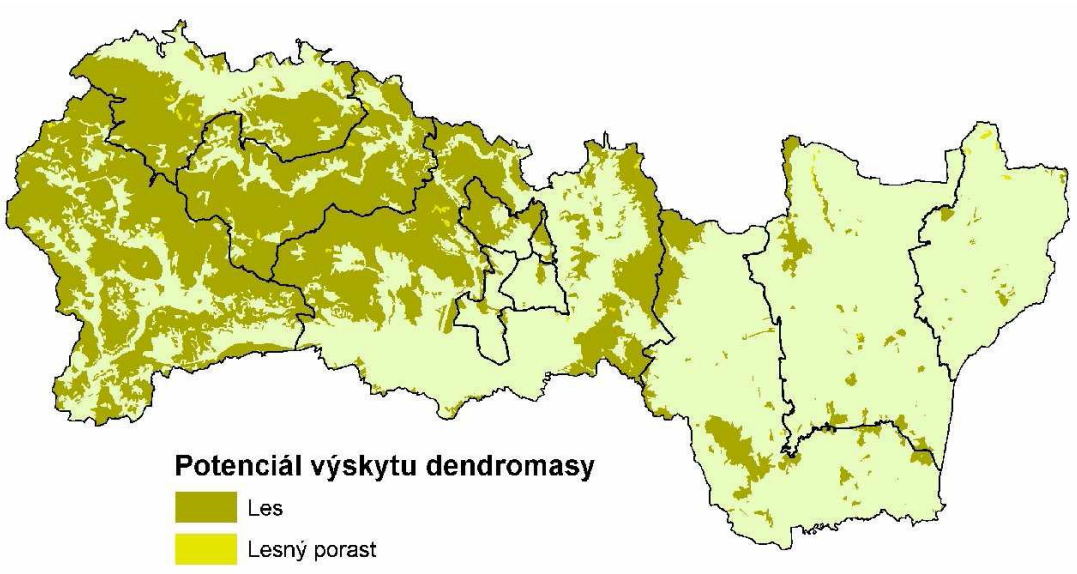


Figure 25: Map of dendromass potential

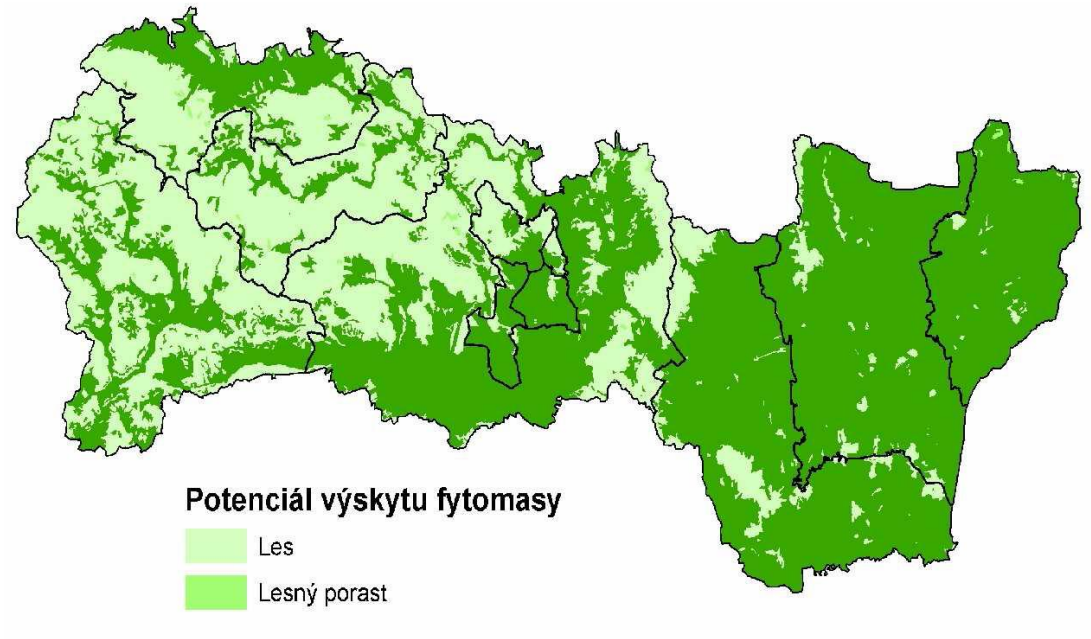


Figure 26: Map of phytomass potential

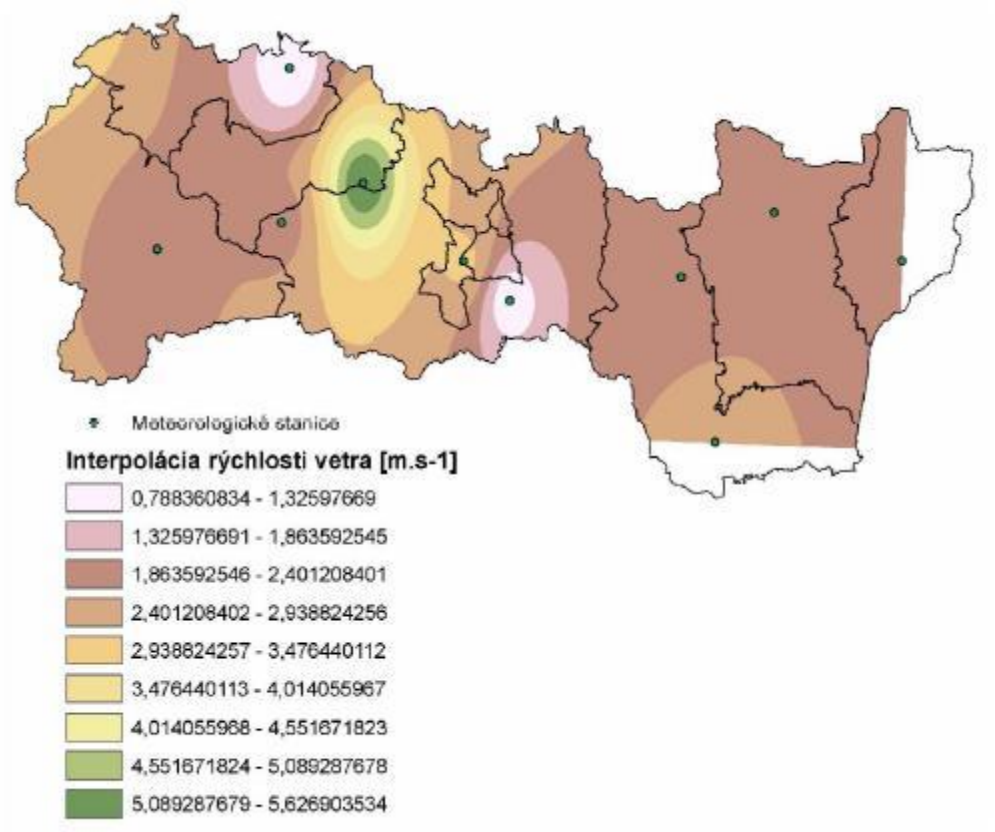


Figure 27: Site utilization of wind energy

9.2.3 Facts extracted from raw data to inform model initialisation

General:

- Available heat technologies: Gas boiler, black coal boiler, biomass boiler (wood chips/pellets, agricultural biomass), heat pump, solar panels, windmills
- Both, the national (Slovak republic) and the regional government (KSR) have a renewable energy policy addressing the goal of increasing the share of renewable sources in the overall energy consumption to 20% by 2020.
- Spatial environment, modelled as a grid of 100x100 cells. Each cell has an attribute denoting its most distinguishing feature, e.g. forest, lake, or housing (see Figure 12).

Producer-related:

- At the time being, only 4% of heating in the Kosice region is produced from renewable sources, namely biomass, whereas the overwhelming majority relies on fossil energy sources (65% gas, 31% coal).
- Current heat supply systems in KSR comprises: small-scale residential boiler houses, block boiler houses supplying heat to several buildings or premises, large-scale systems (e.g. CHP) of thermal equipment supplying heat for a large part of consumers in a town.
- The majority of suppliers are both heat producers and heat distributors. They play a monopoly role in a specific location. They are allowed to operate only with a licence, charging a regulated price for heat supply.
- Nearly all heat is produced by public companies (owned by the state or by municipalities), only 4% by private companies. The main heat producer in KSR is the state-owned TEKO in Kosice. In the city of Kosice, TEHO and KOSIT are other important public heat producers.
- Currently the majority of energy in Kosice Region is generated by the power plants of the Slovak Energy (Slovenske elektrarne) utilizing coal and gas: Elektrárne Vojany I (EVO I) and Elektrárne Vojany II (EVO II).
- The biggest geothermal energy sources are near Ďurkov with the expected installed potential of 100-110 MW11.
- Regulation enables to restrict any annual increase in fixed costs with the exception of making investments into more efficient production and distribution of heat, improvement of environmental performance in the scope of regulations and directions of the European Union and scheduled overhauls.
- The heat price for households (consumers) is made up from several parts as specified in Table 6.
- Heat prices depend on the fuel used to produce the heat (see
- Table 7). Fuel costs represent 65% to 75% on average.

Table 6: Structure of costs in the heat price for households in 2009

Variable costs	56%
Other variable costs	9%

[11] According to Halás, O.: VYUŽITIE GEOTERMÁLNEJ ENERGIE NA VYKUROVANIE MESTA
KOŠICE, Slovgeoterm, a.s., accessible at
http://www.enef.eu/history/2004/programme/2_session_part1/08_Halas.pdf

Limited fixed costs	10,9%
Other fixed costs	19,4%
Profit	4,7%

Table 7: Heat prices by fuel 2009

Fuel	var. comp. households in €/kWh	var. comp. others in €/kWh	fixed component in €/kW
Mixture with min. 20 %-share of biomass	0,0400	0,0407	138,8086
Natural gas	0,0470	0,0540	118,9706
Coal	0,0360	0,0390	113,527

Consumer-related:

- Population of KSR - 778 120
- Population in productive age (15 - 64) - 71,16%
- Population in post-productive age (65 and more)- 11,37%
- Earnings and expenditure:
- average gross nominal monthly earnings of employee in total (EUR) - 442,32 (in 2009);
- the structure of expenditures depicts Table 3.

Table 4 Structure of expenditure in 2009

Average net money income and expenditure monthly per capita of private households	
Net money income in total (EUR)	331,15
Net money expenditure in total (EUR)	308
Consumption expenditure (in per cents)	84,30%
Housing, water, electricity, gas and other fuels (in per cents)	18,90%
Other expenditure (in per cent)	15,70%

- Employment and education:

Table 5 Employment and unemployment according to education level

Employed in total		304,6
	Education:	
	Basic	7,7

	Lower secondary	104,5
	Upper secondary	149,5
	University	42,9
Unemployed in total		**55,8**
	Education:	
	Basic	9,3
	Lower secondary	23,6
	Upper secondary	20,6
	University	2,3

- In Slovakia 95 % of all households are households without electric space heating with consumption not exceeding 5 000 kWh and electric space heating no more than 20 000 kWh.
- In Kosice Region there are 233,932 dwellings; 123,990 of dwelling are in block of flats.
- In January 2009 there were 5 276 dwellings under construction; 1 475 constructions started.
- In 2009, 1 009 constructions were completed: 49 one-room dwellings and flatlets, 125 two-room dwellings, 283 three-room dwellings, 333 four-room dwellings, 219 five-room and more dwellings.
- The average living area of completed dwelling in 2009 was 78,8 m2, in 2008 it was 75,3 m2.
- Number of completed dwellings per 1 000 inhabitants was 1,3 in 2009.
- Electricity consumption in Kosice - 2 414 024 Megawatthour in 2008
- Around 50% of heat is used for space heating and the preparation of hot domestic water
- Gas price in set heat prices for households in 2010: 0,03206 €/kWh
- The total heat consumption in KSR in 2005 was approximately 51500 TJ, of which industry accounted for 48%, the public sector (public buildings) for 18% and households for the remaining 34% (block of flats 9.5%, individual houses 23.5%).
- Most consumers in urban areas are connected to either a central heating provider (66.2%) or district heating (29.4%); only 4.4% of consumers produce their own heating in an individual boiler. This situation is likely to change in the future as there is a trend towards individual heating sources when constructing a new building, unless the building is close to a central heating provider with spare capacity. In rural areas, individual heating sources are the norm.
- Gas price in set heat prices for others than households in 2010: 0,03700 €/kWh
- The heat prices are different for households and other consumers like companies, municipality etc. depending on size of supply.

Table 6 Heat prices for final consumers in 2010

Variable component of heat price in €/kWh

Households	0,0433
Other consumers	0,0491
Fixed component of heat price in €/kW	
Households + other consumers	126,045

- Structure of electricity price for households is as follow:

Table 7 The structure of electricity price for households in 2010 (planned values)

Active power	45,2%	60,2 €/MWh
System operation tariff	4,7%	6,3 €/MWh
Balancing services	7,2%	9,6 €/MWh
Distribution	42,9%	57,1 €/MWh