CORP 2005

GEO·MULTIMEDIA·05

TAGUNGSBAND/PROCEEDINGS

10th International Conference
on
Information & Communication Technologies (ICT)
in
Urban Planning and Spatial Development
and
Impacts of ICT on Physical Space

Manfred SCHRENK (Hg./Ed.)

www.corp.at

C O R P 2 0 0 5

GEO MULTIMEDIA 05

Proceedings of 10th symposion on
INFORMATION & COMMUNICATION TECHNOLOGIES (ICT)
in
URBAN PLANNING AND SPATIAL DEVELOPEMENT
and
IMPACTS OF ICT ON PHYSICAL SPACE

Beiträge zum 10. Symposion zur Rolle der
INFORMATIONS- und KOMMUNIKATIONSTECHNOLOGIE
in der
STADTPLANUNG UND REGIONALENTWICKLUNG
sowie zu den
WECHSELWIRKUNGEN ZWISCHEN REALEM UND VIRTUELLEM RAUM

edited by/herausgegeben von

Manfred SCHRENK (Hg./Ed.)

WIEN, 2005

ISBN: 3-901673-12-1 (Hardcopy-Edition)
ISBN: 3-901673-13-X (CD-Edition)

Im Selbstverlag des Instituts für
EDV-gestützte Methoden in Architektur und Raumplanung
der Technischen Universität Wien, Treitlstraße 3, A-1040 Wien

CORP2005: February 22-25, 2005
Technische Universität Wien/Vienna University of Technology

Herausgeber/Editor:
Manfred Schrenk, Baumgasse 28, A-1030 Wien

Medieninhaber und Verleger/Publisher:
Institut für EDV-gestützte Methoden in Architektur und Raumplanung der Technischen Universität Wien /
Department of computer aided planning and architecture, Vienna University of Technology

Vorstand/Head of Department: O. Univ.-Prof. Dr. Georg FRANCK,
Treitlstraße 3, A-1040 Wien

ISBN: 3-901673-12-1 (Hardcopy Edition)

ISBN: 3-901673-13-X (CD Edition)

INHALTSVERZEICHNIS/TABLE OF CONTENTS

Proceedings / Tagungsband; Ed. / Hg.: Manfred SCHRENK
ISBN: 3-901673-12-1 (Hardcopy-Edition) ISBN: 3-901673-13-X (CD-Edition)

reviewed paper

Prospective Enhancement of Urban Planning Methodology Based on OO Modeling and Rational Unified Process

Vladimir MARUNA[*] *& Marija MARUNA* [**]

[*] BSC EE, Dynamis, Molerova 70/I, Belgrade, vmaruna@eunet.yu,
[**] MSc Arch, Belgrade University, Faculty Of Architecture , Bul. Kralja Aleksandra 173, Belgrade, m.ma@sezampro.yu,

1 INTRO

Objective of paper is to try to define preliminary release for new urban planning methodology[24] based on strong positive knowledge and practice of Object Oriented Methodologies, particular Unified Process and Model Driven Architecture widely used in IT industry. This should be in the same time starting step for the whole process of establishing this methodology which we consider as extremely complex, extensive and long-lasting as it is described later. One of the most important and effective characteristics of Unified Process is its iterative approach resulting in incremental advancement towards targeted goals opposite to the more traditional "waterfall" approach. We suggest the same method for urban planning methodology definition process previously mentioned. Actually, this method suggests to start with simple and small models and methodology elements[25], which may not look useful at the start, and iterative improve it to the complex, strong and valuable methodology at the end. This is the way how modern IT methodology and modeling techniques are built to this level of complexity and expressiveness. Recommended method is especially important for urban planning methodology establishment process as complex and multidisciplinary research of application of formal methods, modeling methods, and theory for the solution of spatial problems including building environment, spatial city or regional structure.

Planning theory and practice currently use several different methodologies or planning techniques but most of them are typically partial, verbal and informal, restricted to the local ambient, non-automated and thus especially difficult to be established within the IT. There is reasonable advancement in the different categories like GIS, Planning Support Systems, Decision Support System, Sketch Design, Modeling and automata theory. GIS, as the most mature one, is still not solution for all and whole problem of urban planning as it is explained in the literature (L8, L18). Planning and Decision support systems are still more in the academic and discussion phase than in actual implementation and use (L11, L13). Automata theory is exceptionally good and already widely used but has very limited implementation covering only narrow problem domain subset (L1, L10). Sketch Design and Modeling are not developed to the useful level despite theirs recent resurrection (L5, L6, L16, L17).

Situation within the IT industry is opposite and we may find emerging standards for Analysis, Design, Implementation, Testing and Deployment of computer based systems which are successfully applied in many vertical industries. Results are improved controllability, quality, efficiency and accuracy of solutions, active participation of all participants, knowledge accumulation, knowledge transfer and at the end complete industry improvement.

Papers propose multidisciplinary research focused on development, advancement and application of formal computer based modeling methodologies for better understanding and improvement of urban systems. Result of this research is not new programming or software tool, ready to solve all possible problems encountered to the planners in everyday work, but it is formal and standardized planning methodology. This methodology may be later used for software tool production as it was the case in the IT industry. For this we suggest as starting point OO Modeling (L7, L16), Unified Process (L12) and Unified Modeling Language (L4, L14). It is obvious that linear and direct application of Unified Process, to the urban systems, is not appropriate therefore localization to the urban domain should occur. Once again we strongly want to recommend iterative and incremental approach to the whole process and therefore we may consider this as a process of establishment of formal planning methodology[26]. Proposed Establishment Process is extremely difficult and complex therefore all participants should take active role. Moreover, it certainly requires a strong and widely supported strategic decision within the urban industry before it even starts. Without this support the whole research is destined to fail since it can not be established properly and will not be used and further developed.

We will emphasize existence of two targeted directions of proposed research. The First considers mutation and application of Unified Process methodology and UML to the urban planning and urban systems domain and the second targets further enhancement of urban planning knowledge and techniques as the result of applied formal methodology. The First direction will question and improve Unified Process and UML completeness and universality through its further enrichment, by adding and generalize domain specific particularities. The Second direction aims to establish new planning methodology as solution for emerging problems found in contemporary urban systems.

2 PRINCIPLES AND ELEMENTS

First, we would like to emphasize several fundamental characteristics, imposed constraints and basic elements of future Planning Methodology and whole Establishment Process. This puts basic frame around future methodology and should establish its strength, usability, applicability, openness, flexibility, adaptability etc. The same characteristic must be applied to the Methodology and Establishment Process as well[27]. Next we will outline some basic elements of methodology and their mutual relationships. At this stage it is not possible to be more specific and strict in order not to close and damage the whole process. Further knowledge, expertise, experience and discussion are required to make procreative steps in this direction.

---

[24] We may use phrase Planning Methodology in further text for better understanding

[25] As it is the case in this paper

[26] We may use phrase Establishment Process in further text for better understanding

[27] This is usual approach in IT to use discourse to improve and further develop the very same discourse (Java, UML etc…)

2.1 Methodology and Process Principle

Here we would like here to recommend several fundamental principles of the future Planning Methodology applicable to the Establishment Process as well. We will also outline possible benefits of every proposed aspect.

First the **Incremental and Iterative** approach is to be used equally within the Planning Methodology and Establishment Process. This approach suggests decomposition of a whole, huge and complex problem to smaller and manageable units. Every such unit is then solved within iteration resulting in increment, as advancement of a whole solution toward targeted objectives. This allows slow but constant progression in intended direction and further direction adjustment after every step making it extremely adaptive and precise. The same method is used within the IT industry in order to cope with extremely complex and unknown problems with extensive success. Incremental and Iterative approach is the first corner stone of Unified Process.

The second is to make Planning Methodology and Establishment Process strongly **Collaborative and Cooperative** (participating) therefore opened to all and every possible actor participation. There is a substantial number of research reasoning on possible benefits of this approach (L13, L15). Once more we should look at the IT counter side. Unified Process is open to all participants especially to non-IT personnel and this is the second corner stone of its success and effectiveness. Considering broad audience of different actors, their divergence of interests and planning objective, if we want to succeed to harmonize this to working and sustainable system we practically do not have alternative.

Collaborative and Cooperative approach has its drawbacks and problems. One of the most widely used may be the question "How?". How it is possible to open planning process to all and everyone and still stay in the control, manage all the participants' contribution, huge amount of gathered data, ensure acceptable quality etc. IT Technology, by itself, has all the power needed for this but this is not sufficient to solve the problem. We would suggest here **Role Based Access** where every participant has appropriate aspect and properly sized presentation of planning artifacts depending on its role, interests and capabilities. In the same time all planning artifacts exist in whole, containing all their richness, on the model **Meta Level**. User will then access only particular aspect of this planning artifact depending on its role. Meta level therefore divides existence and structure of planning artifact from its presentation to the particular participant. This decreases the complexity and makes Collaboration and Cooperation feasible.

Planning Methodology should never be considered to be closed and finished thanks to the general domain complexity and complexity inherited from constant changes within it. Therefore one of its fundamental principles must be **Adaptability to the changes** either because of further advancement of planning techniques, based on experience and knowledge, or on changes in urban systems and human society. Planning Methodology therefore must have built-in techniques and activities for its improvements and enhancement.

Urban system is exceptionally heterogeneous ambient i.e. Planning Methodology has to include a vast number of different specialties and expertise within one working framework in order to gain control over the whole process. That is the reason of making Methodology as an **Integrative platform** for all other tools, techniques, activities including existing ones like GIS, AutoCAD, Automata Simulators etc… This principle should open Meta Model level to all external tools, knowledge and techniques enabling easy information exchange. This is the only way to harmonize all existing and future solutions, to make them to work together and not against[28] as it is the case now.

2.2 Methodology Elements

Methodology in general should answer the following questions: Who, What, When and How. To establish the methodology means to answer every question at every given point of time for every possible actor. Complex project should be divided into phases to manage complexity. Within the phases Actors will conduct particular activities in the particular workflow in order to establish particular artifacts. Therefore basic Planning Methodology elements are Planning Phases, Planning Workflows and Activities, Planning Actors and Planning Artifacts. The latest two are covered in the following chapter. We will try here to establish Phases, Workflows and Actors leaving further detailed development of activities for near future. Once more this is just an outline and suggestion, to start discussion about the matter, and not a final and fixed proposal.

2.2.1 Phases

Every complex problem should be solved and treated through phases in order to decrease complexity level to manageable level. Moreover phases should be repeated if substantial changes, which are inevitable for dynamic complex system, have happened in order to adjust the solution to those changes. This process progresses in repetitions and therefore may be called Cycle. Since they are constant through the system Life we may call them Life Cycle. Unified Process suggests four phases for software development process named: **Inception, Elaboration, Construction and Transition** (L12). IT Development process recognizes construction and transition as separate phases because it is possible to produce solution and then to install it and use it. Planning problem is somehow different as it is not possible to separate the last two in separate phases. To be exact, result of planning is not a tool or software component which may be used, but it is a set of Criteria, Policy, Regulations, Procedure, Legislation and Descriptions to be continually and consistently applied to urban system. Moreover, IT considers any adjustment, within the Transition phase, as reparation of an error, established either during the analysis and design or implementation. Adjustment is then exceptional in nature. Planning, on the other side, will consider any correction, to the changing environment, as natural and immanent to the domain and therefore regular. Accordingly to the previous we will suggest three phases for Urban Methodology named as: Inception, Elaboration and Implementation.

Inception[29] is a phase aimed to establish the clear vision of problems within the domain, to gather main requirements from the Actors, to establish starting set of Goals to fulfill, starting and basic Policy and Criteria. This should answer to the question like: what

[28] UML established as good mixture of three different methodologies: OMT, Booch and Objectory

[29] more or less same as within the Unified Process with few different verbs and/or nouns

are current problems within the urban systems, how difficult are those problems for particular actors, how difficult are those problems to solve at this level of knowledge, what we can propose to solve it, is this feasible, what are basic time constraints etc. This phase should firmly establish "the case" in all aspects including commercial, social, urban, construction, legislative etc. At the end all major problems are recognized and directions to the solution of those problems are outlined. This phase should consider all higher level policies and regulations, national level and upper, in order to comply with them and suggest compatible directions.

Elaboration is phase of establishing a detailed and deeper knowledge about the problem domain and of production of planning artifacts aimed to solve those problems. Deeper understanding should include deeper and wider knowledge about the problems, actors and theirs requirements, actors' interests and everything significant regarding the problem domain. This phase is used also to produce Plan with all its artifacts like, Vision, Goals, Policy, Criteria, suggested implementation Activities, further map-like and verbal descriptions of plan aspects etc. Plan is established through set of alternatives which are evaluated using Evaluation Criteria, established and corrected within the same phase, with active participation of all Actors. At the end one of the presented Alternatives, improved through several iterations, is adopted as a Plan.

Implementation is a phase of putting into the practice previously adopted as a Plan, conducting suggested implementation activities, considering all planning description, procedures, regulations, legislation, policy etc. This is ongoing phase where all changes in real space (ideally) should comply with planned constraints and procedures. Nevertheless, the real ambient is changing all the time and the Plan should face reasonable corrections to manage those changes. Constant monitoring of real ambient and evaluation of changes, within it, should be conducted, during this phase, in order to evaluate actual Plan results. This also may require Plan correction to improve its impact to the real problems. However correction should not be substantially and fundamentally different from the Plan starting version or, if this is the case, new Life Cycle should be started.

2.2.2 Workflows

All previously described phases are executed through set of activities suited to particular phase inputs and required outcome. Same activity may be repeated within different phases and actually all activities may be repeated with every phase if it is suitable. Activities are executed by particular Actors, in order to develop and establish particular planning artifact. Artifact may differ in complexity, importance, quantity etc. Set of related activities is usually called workflow. Unified Process recognizes five workflows: requirements, analysis, design, implementation and testing. Urban environment is considerably different than computer based system where for example it is not possible to have requirements before the analysis of urban situation as it is possible to have all future user requirements before full analysis of the domain. We can name even more differences but this is out of the scope of this document. This difference forces us to change workflows and order of execution. Proposed workflows should be matter of careful revision of industry professionals and authorities in order to check completeness and correctness of proposed workflows and activities. This is also main reason why we could not propose, at the moment and with current knowledge, detailed list of activities for the whole process.

We will propose, at this moment, following workflows: Urban and Spatial Analysis, Requirements Analysis, Plan Design and Plan Execution and Evaluation.

Urban and Spatial Analysis establishes full and precise description and specification of all important aspect of treated urban system including: spatial[30], social, economical, legislative and other aspects and elements etc. Result of the analysis is a set of models, maps, sketches and other descriptive forms describing the urban system in all important details and aspects. Analysis should recognize and specify basic problems in treated urban system using modeling, simulations, external data sources and tools and other useful techniques and tools to reveal hidden elements, theirs structure, behavior, mutual and possible complex relationship etc.

Requirements Analysis establishes full collection of all Actors' requirements including citizens, experts, government, investors etc… Requirements must include Regulations and Policies established on higher level in order to make final outcome compatible with them. Requirements analysis then recognizes and specifies the Actors' interests, for every Actor group, and how different interests forced by different actors are related (conflicted, compatible or inert) trying to establish minimal set of requirements accepted, or at least not opposite, to every Actor group. Identified minimal set is then promoted to the Planning Goals and should be targeted in the following Workflow. Requirements Analysis workflow may also include verification of promoted Goals through public debate. Defined set of Goals is then followed with related set of Criteria used to evaluate fulfillment of particular Goal or set of Goals used later within the last workflow to calculate the level of Plan accomplishment. All artifacts should be result of partial or full cooperation and participation of all the Actors accordingly to the Cooperative and Collaborative principle defined above.

Design establishes the Plan with all its details through set of Alternatives. Every Alternative works with result of previous workflows since it is situated within the problem domain trying to solve specified problems, defined in the first workflow, complying with Goals, Policies and Regulations defined in the second workflow. Every Alternative is actual Plan sketch developed to the level sufficient to understand basic idea and outcome of planned solution. This is the moment where all the Actors should participate in and where their participation makes substantially impact on the final solution. When consensus is established chosen Alternative is further developed into the Plan. During this workflow some of previous elements may be improved and slightly changed according to the new knowledge and experience collected within the Design workflow, Actors' interactions and discussions.

Execution and Evaluation uses previously defined Plan and executes all its implementation activities like Procedures, Regulations, Policies, Legislation using defined Goals, Map-like or verbal descriptions of particular Plan aspects etc… The plan is here more like Expert Knowledge Base used for consulting purposes than a predefined description and specification of everything and everywhere. Nevertheless, every activity within the urban system may not violate clearly and precisely defined Plan Policy, Goal or Regulation or may not disobey clearly defined Procedure, Regulative and/or Legislative rules. This workflow includes constant monitoring over

[30] We use this word to cover everything in real tangible world like buildings, infrastructure, natural resources etc…

predefined set of urban system variables and evolution of measured changes against predefined Plan Set of Criteria. This evaluation process will reveal the Plan impact on targeted problems and may require Plan corrections. In normal situation those corrections are not extensive but may improve real impact of Plan implementation. In other case, if substantial correction is needed, this workflow signalizes "major flaw" resulting in next Phase or even next Life Cycle starting.

It is essential not to relate proposed workflows within with only one of the previously described phases, like for example Urban and Spatial Analysis with the Inception phase, but to understand that every workflow has to be used to particular extent within every phase[31]. Although, it is most likely that particular workflows are used mostly with particular phases this should not be always the case and certainly should not prevent use of particular workflow within the particular phase. Later, after new knowledge and experiments arrive, we may reconsider this decision and then we may suggest constraints over relationships between phases and workflows.

2.2.3 Actors

This is the least known element of the whole Planning Methodology but we should still offer starting set and therefore we will define a very simple set of Actors' classes named: Experts, Government, Investors and Citizens (L15). All the Actors are participating in "real life" and in the same time they are participating in the Planning Process. This is a direct consequence of Collaborative and Cooperative principle we established above. What we see in near future is further decomposition of Experts group because its importance for Planning Methodology improvement. Other Actor classes may be further decomposed but in not more then two or three levels just to accomplish better Planning Methodology and Model granularity.

Citizens are main sources of requirements and also a main supporting force. They will identify the main subjects within the problem domain together with the Investors and will improve understanding of planning and its frame together with government. Citizens will therefore intensively participate within the Requirements Analysis workflow but may make substantial contribution to the Urban and Spatial Analysis workflow. They certainly may participate in Design workflow and therefore help to find the best Alternative.

Investors are main developers with necessary power to make changes in real space. Investors Actor includes almost certainly two subclasses named: Pure Investors and Developers, but this distinction is not considered as important on this level. Investors will identify the main subjects within the problem domain together with the Citizens and will establish strategic framework necessary to reach agreements together with Experts. Investors will also intensively participate within the Requirements Analysis workflow trying to promote their interest. They will also intensively participate within the Execution and Evaluation Workflow during their construction activities. They may participate in Design workflow but more as Citizens then Investors.

Government represents management and decision force capable to administer and supervise the whole process which is authorized, by election, to make decisions. They will improve understanding of planning and its frame together with Citizens and will define all conditions, constraints, policy and regulations with Experts. They will participate intensively within Requirements Analysis, to define Policy, Design workflow, to make final decision over the best alternative, and certainly as authorization authority within Execution and Evaluation workflow.

Experts are the most interesting group of players, from the Methodological point of view, and should be developed and decomposed in near future in order to specify activities and workflows in all details. Experts are, currently, covering all workflows and all consulting and know-how activities within the workflows.

Please be aware that **one individual may play several Roles** over the time like for example one may own construction company and may play Role Investor, on the professional basis, but may also live in same zone and play Role Citizen on private basis. You should take this into the account while reading the previous definitions.

3 LANGUAGE AND META-MODEL ELEMENTS

Above are listed Phases, Workflows and Actors. Actors are executing activities[32] within the Workflows, during the Phases, in order to produce Planning Artifacts. Every Artifact will define, explain or specify particular aspect or element either from problem or solution domain. Although those aspects, elements and models differ substantially in nature, structure, semantics, syntax, behavior and many other qualities we should try to establish unified language to be used in their description and specification. This language must be standardized and opened to the public. Moreover this language must be well suited to the problem domain in order to grasp strength, preciseness and effectiveness required to manage complex domain of urban phenomenon.

3.1 Language

Complexity of Urban Phenomenon is substantial and therefore we are not capable to establish proper and useful language at this time and with this level of knowledge. What we could suggest at the moment is to use OO approach for the Language, to try to establish it as graphical language and to use UML for the description of its starting elements.

We should always keep in mind Iterative and Incremental approach which is especially useful in this situation. What we have to do, since complexity is substantial, is to try to make a simple starting version and then to improve it in several iterations. Even if first release is not expressive and of any use, we may in subsequent iteration establish first practical version of it, and then we can work on its constant improvement in the following iteration.

[31] Same approach is used in Unified Process and it becomes one of the main drivers of whole process.

[32] Still not defined

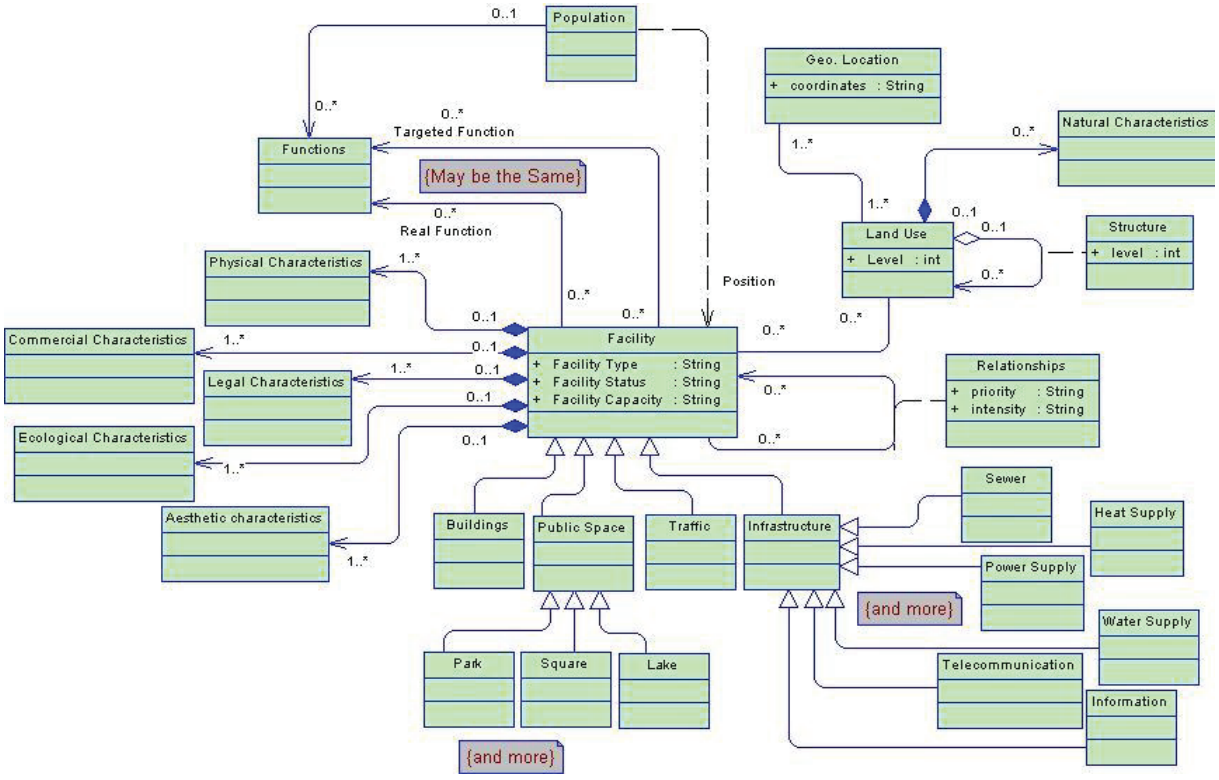

Figure 1 Outline of possible OO Meta model language elements for Urban Planning Methodology – Spatial Elements

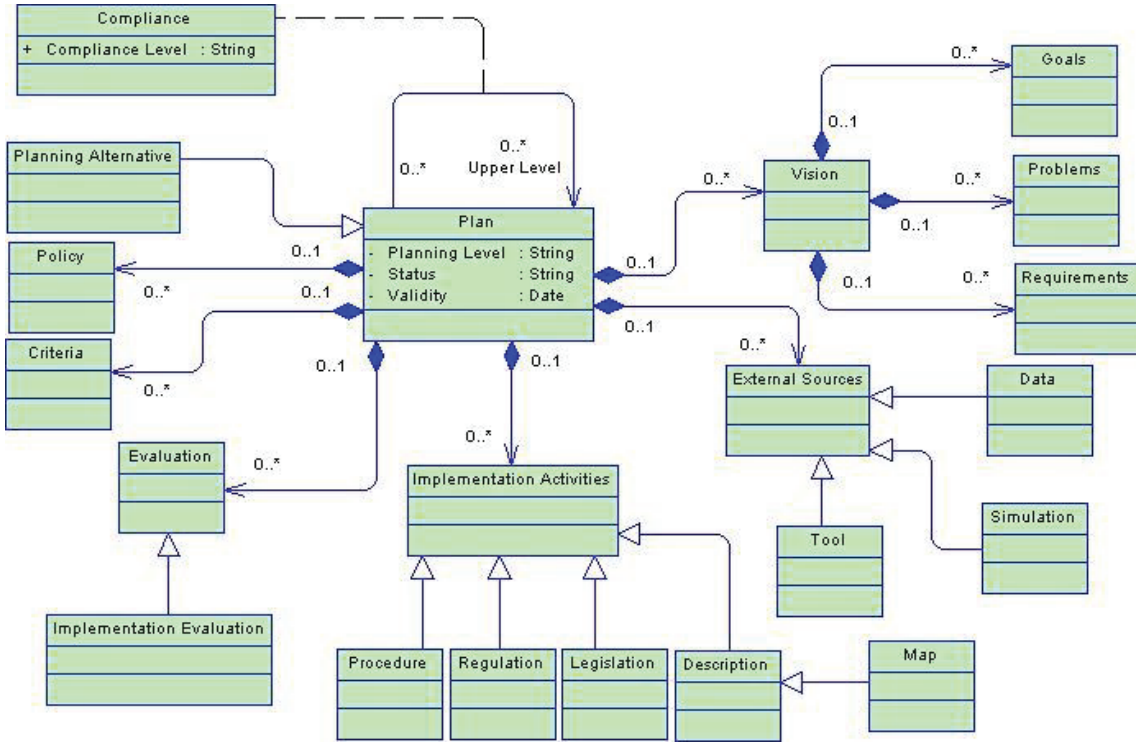

Figure 2 Outline of possible OO Meta model language elements for Urban Planning Methodology – Planning Artifacts

After Language Verbs and Nouns have bee established and approved in several iterations and projects we may consider moving it to the Meta model level (L7, L14, L17). Meta model level contains Language constructs, their mutual relationships, syntax and semantics, constraints, visual characteristics etc. This will be opening point for a planning tool development.

To illustrate the whole process and problem, and only in that purposes, we are presenting above, on Figure 1 and Figure 2, a simple sketch of probable language elements regarding Spatial Elements and Planning Artifacts. These two diagrams are presented only to demonstrate OO approach to the domain and will express only main verbs and their relationships. Attribute and other endorsement are deliberately avoided for simplification, readability and descriptiveness purposes.

3.1.1 Spatial Phenomenon

We will explain just in few sentences elements and relationships presented as first outline of possible language elements to manage and describe spatial phenomenon.

The main entity is **Facility** which represents any object, natural or constructed, within the urban space including, buildings, public space, roads, transportation[33] and infrastructure[34]. Facility is then specialized into four general subtypes named **Buildings, Traffic, Infrastructure** and **Public Space**.

Building represent any kind of constructed object used for various purposes including industrial buildings, housing, schools, medical posts etc… We also recommend distinction of facilities used for **Traffic and transportation** purposes because of their special characteristics, features and substantial importance. Other **Infrastructure** elements are put together since they have many common characteristics, given that they are used for supply of some goods like electrical power, water, information, communication, heat etc. At the end **Public spaces** are important and inevitable elements of any urban space and therefore have to be identified as a separate entity. We presented few possible elements of Public Space and Infrastructure just to explain an idea better. All relationships between Facility, Buildings, Public Space, Traffic, Infrastructure and others, relationships with closed arrow, are represent "kind of" or inheritance relationship (L3). Facility then represents more general class and Buildings specialized version of it inheriting all features of Facility and adding few more (L4).

Facility is related with other facility through their **Relationships** like for example instance of Building (Office) is related with instance of Traffic (Road) which is related then with another instance of Building (House) to represent Office-Road-House path. This is usual graph approach where nodes are instance of Facility and lines are instance of Relationships. On this way we move richness and complexity of real traffic to Facility and enable easy Path analysis, simulation etc. Relationships are endorsed with priority and intensity and may be later endorsed with Path name etc…This generalization may, from our point of view, considerably simplify analysis, sketch planning and simulation. Simple arrow used in this case represents only dependency of any kind (L4).

Every **Facility** is characterized with the number of different characteristics where we listed just a limited number like **Physical** (Height, Width, Number of…), **Commercial** (Building Value, Expected Rate…), **Aesthetic**, **Ecological**, and **Legal** (Ownership) etc. We postpone further generalization for following iterations. Line with the full diamond on one end represents composition of Facility from available full set of characteristics (L4).

Facility, and therefore all descendants, is represented as object without **any function** and any **real geographical attribute** built within it. Those two qualities are extracted in separated entities to enable management over the Facility, Functions and Land Use independently and on different stages and phases of modeling. Functions are separated from Facility to model real situation where particular Facility (Building) may be used for different purposes, like for example an old warehouse for fancy apartment etc. Actually Functions of the Facility are separated from it and may be changed during its life cycle. Separation of geographical domain is more serious and has to introduce complete separation of Urban System from its geographical representation. Planner will decide, using this approach, where and when to interfere with the geography and where and when to stay out of it. Consequently Facility may be situated in one or more element of Land Use, like for example Parcel, and one element of Land Use may hold none, one or more Facilities. On the other hand every Facility is associated with none, one or more Targeted Function (planned) and with none, one or more Real Function (real use). Those two sets may differ, this difference may be established during Facility Life Cycle, or may be the same.

Different configurations of **Land Use** are represented with the association class **Structure** where level represents actual granularity. Land Use element may have Natural characteristics like Height, Quality of land, rivers, mountains etc. Finally Land Use Element is associated with actual geographical coordinates to link modeling with the actual geography.

At the end we present general entity for **Population** just to outline their use of Functions, associated with the Facility, to fulfill their needs. Population has to be actually within particular Facility, at given Position, to use its Function but this location may change over the time either within the same Function, traveling for example, or with change of Function like Shopping at Mall and Resting at Home.

We want to emphasize fact that this is only one expressive example for prosper use of OO within the urban systems domain.

3.1.2 Planning Artifacts

Second Diagram outlines structure of Plan as general OO entity. Presented Plan does not actually represent any real plan, well known from planning practice, and certainly does not suggest this structure to any real plan as well. This is represented just for the purposes of this paper as general structure of possible Plan elements which are then used through text especially within Workflow description section. Therefore this is Dictionary-Like explanatory Diagram.

The Plan is composed (diamond arrow (L4)) of sets of statements of different kind Policy, Goals, Evaluations, Implementation Activities and Visions. All this different elements are used to describe Workflows. Planning Alternatives are a "kind of" Plan but with reduced level of details and expressiveness. The Alternative Plan becomes Plan after the adoption process. The Plan may form

[33] of any kind

[34] of any kind

Hierarchical structure where higher level Plan imposes set of Constraints, in form or Policy, to which lower level Plan has to comply with certain level of compliance. We presented on the diagram few "kinds of" Implementation activities like for example Procedure, Regulation rules, Legislation Rules and general kind of Description to express the Plan in more details. Maps are only one kind of possible Plan Descriptions. At the end we suggest use of External Data Source to comply with Integration principle presented above where the Plan has to include all the data used within the Plan, for Alternatives and especially used to make good decisions, like External Data, Simulation Results and External Tools. This may be the start of using this methodology as Integration Platform.

4 VISION AND BENEFITS

We tried to reason, in this paper, about two different but related matters. First is how to start and manage process of establishing starting, and subsequent iterations, for Planning Methodology. Second is what might be the basic elements of future Planning Methodology itself. For this purposes we use positive experience found in IT like OO/UML and Unified Process as starting point.

What we suggest is to use Iterative and Incremental method for the mentioned process and to start building Planning Methodology from simple and understandable elements toward more complex, effective, descriptive and usable version of it with active participation of all relevant and interested domain players.

At the same time we put some basic principles and elements of future Planning Methodology in place for discussion purposes. We find Iterative and Incremental method equally important for Methodology itself as it is important for the process. At the same time this methodology must enable strong Collaborative and Cooperative environment for all and every actor within the domain, based on separation of Roles and concerns, adaptive to constant changes within the domain. At the end this methodology has to establish Integrative platform for already existing efforts, researches and results.

Finally we identify three phases, Inception, Elaboration and Implementation, with four workflows, Urban and Spatial Analysis, Requirements Analysis, Design and Execution and Evaluation, four basic classes of Actors, Citizens, Investors, Government and Experts. We presented here OO approach and outlined basic entities of future Unified Language and basic structure of Plan as one of the main Artifacts within the Planning Methodology.

What we suggest is to establish usable version of Planning Methodology with reasonable detailed definition of Phases, Workflows, Activities, Artifacts and Actors described with unified and standardized spatial language, with clean and strong Meta model definition, accordingly to the proposed, and possibly extended, principles in open, public and broad discussion through subsequent iterations.

Along the path of this complex, difficult, heterogeneous and never-ending research we perceive promising set of improvements of the industry from which we will list just few:

- Improved **controllability** over the planning process and certainly over the implementation of Plan as a result of carefully developed Phases, Workflows and Activities,
- Enhanced **adaptability** to the changes in the domain either for implementation or for planning activities based on built-in methodology adaptability and evaluation activities,
- Increased **descriptiveness, expressiveness and preciseness** of all planning artifacts especially for implementation activities because of use of standardized and unified language,
- Robust and strong tool/methodology capable to **manage complexity** of urban system based on OO approach and standard planning techniques,
- Better **level of integration** capable to include virtually every external data source, simulation or tool and to pro-actively use this for planning and decision purposes as a result of OO technology, public and opened standards,
- Substantially better **knowledge accumulation and transfer** based on used unified language, clearly defined methodology, and used public and opened standards,
- Support for Planning Methodology by (Semi) **Automated Tools** developed over and on account of unified language, its Meta Model definition and standardized Methodology elements and
- Significant **improvement** of the whole industry as a final result as it has been the case with IT industry[35].

Proposed Process as well as the Planning Methodology is extremely difficult and complex therefore all participants should take active role within it. This process certainly requires strong and widely supported strategic decision within the industry before it even starts. Without this support the whole research is destined to fail since it can not be established properly and will not be used and further developed. Only widely used solution will survive and grow.

[35] Latest advancement of IT are OO DBMS and executable UML where skilled user may produce application directly from UML Diagrams

5 LITERATURE

1. Batty, M., Jiang, B. (?). *Multi – Agent Simulation: New Approaches to Exploring Space – Time Dynamics Within GIS.*Centre for Advanced Spatial Analysis University College London, http// www.casa.ucl.ac.uk/working_paper10.pdf
2. Batty, M., Torrens, P.M. (2001.). *Modeling Complexity: the limits to prediction*. Centre for Advanced Spatial Analysis University College London, http// www.casa.ucl.ac.uk/working_paper36.pdf, October 2001
3. Batty, Michael. (2004.). *A New Theory of Space Syntax*. Centre for Advanced Spatial Analysis University College London, http// www.casa.ucl.ac.uk/working_paper75.pdf, February 2004
4. G. Booch, J. Rumbaugh, I. Jacobson, (1999), The *Unified Modeling Language User Guide,* Addison-Wesley
5. Galle, P. (1991.). *Alexander Patterns for Design Computing: Atoms of Conceptual Structure.* Environment and Planning B: Planning and Design, vol 18, p. 327-346
6. Galle, P. (1994.). *Computer Support of Architectural Sketch Design: A Matter of Simplicity.* Environment and Planning B: Planning and Design, vol 21, p. 353-372
7. Gamma, E., Helm, R., Johnson, R., Vlissides, J. (1995.). *Design Patterns – Elements of Reusable Object – Oriented Software*. Addison – Wesley
8. Harris, B., Batty, M. *Location Models, Geographic Information, and Planning Support Systems* in Brail, K.R., Klosterman, R. (2001.). *Planning Support Systems.* Redlands, California: ESRI Press, pp. 25-57
9. Harris, Britton. *Sketch Planning: Systematic Methods in Planning and Its Support* in Brail, K.R., Klosterman, R. (2001.). *Planning Support Systems.* Redlands, California: ESRI Press, pp. 59-80
10. Hopcroft, J.E., Motwani, R., Ullman, J.D. (2001.). *Introduction to Automata Theory, Languages, and Computation.* Addison-Wesley
11. Hopkins, D.Lewis. *Structure of a Planning Support System for Urban Development* in Brail, K.R., Klosterman, R. (2001.). *Planning Support Systems.* Redlands, California: ESRI Press, pp. 81-98
12. I. Jacobson, G. Booch, J. Rumbaugh, (1999), *Unified Software Development Process,* Addison-Wesley
13. Klosterman, Richard. *Planning Support Systems: A New Perspective on Computer-aided Planning* in Brail, K.R., Klosterman, R. (2001.). *Planning Support Systems.* Redlands, California: ESRI Press, pp.1-23
14. Larman, Craig. (2002.). *Applying UML and Patterns, An Introduction to Object-Oriented Analysis and Design and the Unified Process.* Prentice Hall PTR
15. Lazarevic-Bajec, Nada, *Modern Urban Planning, (2002.). Principles of modern government over local society*. Belgrade, Center for liberal democratic studies.
16. Lea, D., Oswego, S., (1997). *Christopher Alexander: An Introduction for Object – Oriented Designers.* www.patternlanguage.com
17. M.Maruna, V.Marun (2004), *IT Modeling Experience in Urban and Regional Development*, CORP 2004,
18. Putra, S.Y., Wenjing, L., Yang, P.P. (2004). *Object – oriented GIS Data Modeling for Urban Design.*