Theoretical Framework for Best Practice Integrated Planning Model

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Abstract:

The new EU policy for climate protection and promotion of renewable energies introduces under other strategies the concept of buildings as power plants. This concept is based on so called Energy-Plus-House, the next generation of Passive House – a building that would produce more energy than it consumes. Even though the institutional policies do promote the new, innovative forms of buildings and technologies, the innovation of planning and construction processes which are necessary for achievement of such complex planning aims as sustainability is hardly considered. Integrated planning has often been recommended by both literature and practice as solution for planning of energy efficient buildings as complex systems however the research of integrated planning itself has not been qualitatively and quantitatively evaluated or discussed yet within institutional, societal or practical framework.
Exactly this objective is one of the main aims of the research project Co_Be: Cost Benefits of Integrated Planning, the theoretical framework of which will be introduced in this paper. Based on practical research through case study methodology of energy efficient buildings, a best practice integrated planning model will be proposed, upon which the implementation strategies for planners, investors and policy-makers will be developed.

Key Words: Integrated Planning, Life cycle approach, Energy Efficiency, Case Study Research

Introduction

The future actions of the European Union for climate protection and energy supply will be based on “post-carbon society” concept, which again focuses on low energy (energy efficiency measurements), low carbon (renewable energies and withdrawal from fossil fuels) and low distance (short routes) guidelines (Vogel, 2010).

Low carbon especially focuses on fundamental tripod of: use of renewable energies, energy storage and smart grids (Carvalho 2009). Carvalho describes the concept of "buildings as power plants", with integrated technologies for energy production from renewable resources such as sun, wind, geothermal energy, biomass, waste and waste water-heat playing crucial role in the realization of the "post-carbon-society" construct. Within the element of smart grids, energy-producing buildings will enable the homeowners to become energy producers and energy-owners, allowing the social change ("empowerment of citizens") through democratization of energy production.
Even though much attention has been drawn to the technology, construction and standardization of evaluation methods for "energy-plus" buildings, little effort has been made to crucially rethink the planning processes for new buildings. The complexity of planning requirements and aims for energy efficient buildings has significantly risen, however the buildings are mostly planned with traditional planning methods based on sequential model.
So called Integrated Planning has been recommended by the literature (König et al, Mendler, Prowler) and practice as one of the key factors for realization of the energy efficient buildings however hardly any literature actually develops a planning model or offers thorough qualitative or quantitative evaluation of best practices.

Project Co_Be

This paper will present the theoretical framework of the research project Co_Be: Cost Benefits of Integrated planning. The aim of the project is qualitative and quantitative analysis and simulation of the life-cycle cost-benefits of Integrated Planning (IP).
The final goal is the compilation of 3-module **Integrated Planning Guidelines** for planers, investors and policy makers. Middle-term goal is implementation of strategic steps for integration of climate protection and energy efficiency aims within planning processes through policy but also through growing awareness among stakeholders (investors, users).
This interdisciplinary project of Vienna University of Technology is funded from the means of Austrian Climate- and Energy Funds within framework of the Program „New Energies 2020".
The project coordinator and initiator is Institute for Interdisciplinary Building Process Management, Department for interdisciplinary Planning and Industrial Building, further partners are Institute for Urban Planning and Design, Department for Real Estate Development and ATP Sustain Company.

State of the Art/Point of Departure

Up to 40% of total energy consumption in the EU is used for cooling and heating of buildings. 20% of CO_2 emissions in Austria are caused by buildings. At the same time the building sector contributes with 10% to GNP and is as such an important branch for implementation sustainability measurements, which can also be seen as economic impetus for building industry – key word green jobs (DGNB,2008).
Planning phase can be seen as critical for achievement of energy-efficiency aims (Achammer, 2009), since the change potential rapidly decreases whereas the cost rapidly increase with the project progress. In the construction-preparation phase the change potential is already halved, however the tendering process represents an important instrument for transfer and quality control of sustainability aims in construction phase.
Life cycle cost evaluation for the life duration of a building of 80 years points out on construction cost towards following cost ration of 20%-80% (Floegl, 2009), which

strikes the importance of the planning phase, influencing the largest part of life cycle cost.
Schwarz (2007) implies on optimization of life-cycle energy performance of a building through use of new materials and intelligent skins and mechanical services from 30-50%.

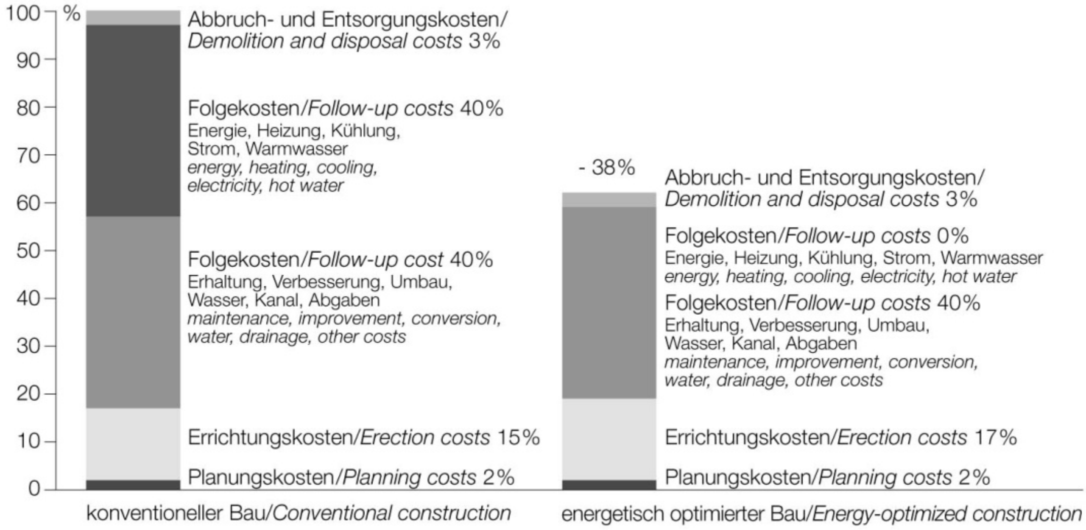

Figure 1: Life cycle costs of conventional vs. energy-optimised planning process (Schwarz, 2007)

The recent literature also emphasizes the importance of interdisciplinary integrated planning in connection with energy efficient sustainable buildings.
Guzin Müller (2002) recommends employment of traditional planning techniques combined with implementation of new technologies for energy efficiency, strongly emphasizing social aspects of users' involvement in planning and future use of the building through participatory planning method.

In the realm of engineering design new design methods were developed basically for reduction of lead times due to the decreasing product lifetime versus increasing product development time. Yazidani and Holmes (1999) identify four relevant design models for the product development: Sequential, Design Centered, Concurrent and Dynamic.
Sequential also traditional model is based on sequential input of design activities; process is repeated until the satisfactory solution has been found. This model negatively effects time, costs and design quality.
Design Centered Model requires higher level of design analysis at the front end of the process; predisposition of which is consideration of design-requirements of all members of design process. The process is still sequential, however the knowledge of design information is much higher. The design quality is higher than in the Sequential Model.
Concurrent Model works on the downstream level, where two consequent phases have overlapping interval where information can be exchanged. Each phase has a gate attached for review of the master design. Costs are minimized through overlapping intervals by team-risk analysis, observed design quality is medium.
Dynamic Model introduces much more intensive level of communication from the project beginning, since all the activities start simultaneously. However this model requires the highest level of integration, meaning the tools for cross-sectional information exchange, shows best performance in terms of costs, time and quality.

Yazidani states that this model can be implemented only in companies with very flat organization, requiring fully dedicated multi-functional project team.

Further notion is life-cycle oriented “Whole-Building-Design”, based on two foci: the integrated design approach and integrated team process (Prowler, 2008). On the one side there are the design or planning requirements for building performance to be met on holistic level, identified in this particular model as: accessibility, aesthetics, cost-effectiveness, functionality, historic preservation, productivity enabling (well-being of occupants), safety, sustainability (environmental performance of building elements). On the other hand there is integrated team which includes every stakeholder of the planning process, united in so called design charette – collaborative brainstorming session encouraging the exchange of ideas but also enabling full understanding of all the parties as well as of set aims at the project start. This concept has also been largely adapted in HOK guideline for planning of green buildings, where a flow chart and check list for the integrated planning process is precisely outlined. (Mendler, 2006)

Kohler introduces an Integrated Life Cycle Assessment (Kohler, 2007) which would integrate and evaluate the environmental impacts as well as initial and life-cycle cost related to gross floor area (GFA) of different granulations for macro, micro elements or construction works according to relevant planning phase, already beginning from programming or project development. Such a tool would require a large amount of building related data of different granularity, in order to be applicable in every phase and by every planning stakeholder. Kohler and Lützkendorf (König et al, 2009) therefore employ a notion of IP as “performance based building”, with necessity for of interdisciplinary (horizontal – planning profession related) and life-cycle oriented (vertical – building oriented) integration. Early implementation of simulation and prediction tools for later building performance for enabling of optimization in the early planning phases such as integral simulation with related databases is necessary method but hardly established on the market yet due to the lack of commercial tools.

Therefore is BIM (Building Information Modeling) often seen as operative solution for IP, since such a tool would unite the fragmented models (architecture, structural engineering, HVAC (heating, ventilation, air conditioning)) of planning disciplines into one interactive building-model together with methods of life cycle costing, life cycle assessment, thermal building simulation, in an integral life-cycle oriented building representation.

Underlying hypothesis

The current research of design and consequent performance of green buildings has identified several crucial factors for their success (Torcellini et al, 2006).

A *clear aim setting* with definition of measurable quantitative and qualitative aims at before of the beginning of the planning process represents a point of departure for further successful design and construction process. The aim setting requires for implementation of programming (also known as briefing) methodology advancing to actual planning, where in number of workshops together with programming techniques the actual needs and desires of client are captured and finally presented in a document containing project aims described rather as qualities instead of quantities – defining what, instead how should be build (Penna, Parshal, 2001).

An *integrated life-cycle oriented planning process*, as described by Prowler, involving a number of disciplines from early beginning including a charette as initial start up

workshop for common understanding of vision statement and establishment of commitment to the project aims (in this case being the energy efficiency) of project stakeholders.
Further on Torcellini identifies the crucial role of *investor* for project success – investor is seen as main driving force, but as well as main obstacle if commitment is not there for the realisation of sustainable, innovative buildings.
Sustainable buildings function seldom as planned – the implemented technology needs one to two years for adaptation and optimisation through facility management, which again would require a monitoring and measuring strategy of energy consumption as well as of system performance. Further crucial factor for performance are users and user behaviour. Methods such as post occupancy evaluation (POE) (Wener, 1998) contribute to knowledge on building performance and necessary steps for optimisation. POE brings also the important insights for future planning processes in form of Feed-Back Loop.
Know-How transfer from planning phase into the construction and further on in the operational phase is crucial for the realisation of planning aims, as well as for briefing of facility managers and users themselves for the proper use of technical and building facilities. Strategies such as Web-Sites as opening page for intranet browser with weather information and recommendation for the related use of the building (e.g. when and for how long to open the windows) or a hotline for users instead of building-.manual such as implemented at passive housing development Uttendorf Gasse in Vienna.

Aims of Co_Be

We argue that sustainable buildings on ground of their extensive coherences of economic, ecologic and socio-cultural issues require for new planning processes, which again can be captured under terminus Integrated Planning Process.
The project Co_Be should for the first time empirically analyse and examine the benefits of integrated planning
With increasing demands on building performance, the number of tools for evaluation, prediction and simulation of the energy-, cost- and emissions- efficiency is rising together with the number of experts and the relevant professional languages involved in such a planning process.
Therefore we argue that the planning processes for sustainable buildings are characterised through high level of complexity, and represent complex dynamic social systems.
Special attention needs to be drawn to communication and decision making mechanisms within such processes as well as to organisational structures that would enable the optimal achievement of the aims set for desired building performance.
Efficient methodology for the implementation of integrated planning in the planning practice should be developed, with focus on decision making process, as well as on group dynamics.
Finally the project should increase the awareness for necessity but also for complexity of planning processes for sustainable, energy efficient buildings amongst investors and policy makers. Through project the change in fee structure for architects and engineers should be initiated, since current structures rather discourage than encourage the interdisciplinary integrated planning.

Methodology for Co_Be

The research methodology used for Co_Be is based on practice oriented case study, employing descriptive research method. (Dul, Halk, 2008)

For the case study a number of best practice energy efficient buildings (BEEB) are objects of research. The emphasis lies on investigation of planning processes of BEEB, however also the buildings themselves will be documented (plan and photo material, tables with building performance and description of construction and technology, POE).

The methods used for investigation of planning processes are semi-structured expert-interviews (Bogner, 2005) with stakeholders of planning process such as: architects, engineers, investors, facility managers and users. Further on informal interviews and observation is also employed.

After the first step of investigation and analyses of BEEB a Best Practice Integrated Planning Model (BPIPM) will be developed. The model again will be evaluated by BEEB-experts in order to obtain model-verification.

After optimization, strategies for implementation of BPIPM in the planning practice will be developed in form of Guidelines for Planners, Investors and Policy Makers.

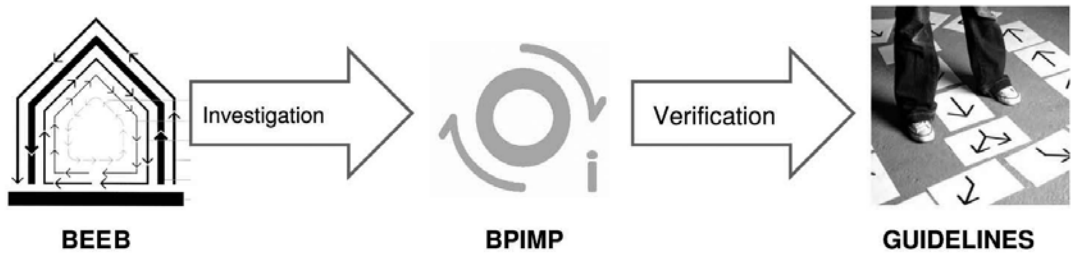

Figure 2: Co_Be work plan

The focus of research is upon office buildings. The research questions to be answered are:

- Identification of the differences between the implementation of sustainability aims for buildings build for own use and for rent or sale (so called investor architecture).
- Analysis of planning teams, their efficiency, methodology and planning benefits. Investigated are so called “networks” of smaller planning offices and studios (Hartmann, Fischer 2009) and “general contractors” (GC) where architecture, structural and mechanical engineering originate from the same house, together with sequential and hybrid models.

Further on the interviews with the planning process stakeholders build upon the underlying hypothesis for integrated planning and aim to verify the state-of-the-art identified crucial criteria.

Tab.1 : Case Study Object-Matrix

Planning teams		*Building*
	Own use	Energy-Efficient (GCO)
„GC“		
	Rented	Energy-Efficient (GCR)
	Own Use	Energy-Efficient (NO)
Network		
	Rented	Energy-Efficient (NR)
Sequential	Own Use	Energy-Efficient (SO)

Further on a quantitative and qualitative analysis and evaluation of traditional, consecutive planning processes and integrated planning will be carried out on hand on role-playing experiment. The experiment will be carried out within the course “Building Process Management” for students of fourth semester of civil engineering together with higher semester architecture students. Planning teams including five roles of an architect, civil engineer, project manager, client and contractor will be split into two clusters: cluster of traditional planners (CTP) and cluster of integrated planners (CIP). In CIP *team-members* are grouped together and work on the given assignment simultaneously. In the CTP *the roles, instead of teams* are grouped together, and work on the assignment consecutively - scripts for temporal scenarios will be developed e.g. as follows: beginning discipline is architecture, the discipline of structural engineering follows in strictly given time period, etc. In the evaluation, the designs will be judged upon the preset criteria such as costs, construction and material efficiency, sustainability, design.

Conclusion

The first interviews with the stakeholders of planning processes of BEEB were carried out with architect, investor, HVAC-engineer for buildings GCO and GCR; and facility manager for building SO (Table 1).

The first findings imply on the process based difficulties:

- The belated introduction of certain disciplines into the planning process, especially HVAC engineer and facility management
- The unbalanced knowledge and experience in the issue of sustainability and energy efficient planning within planning team
- Different professional languages and related misunderstandings, which often have origin in the point described above– simply not being familiar with the matter of energy efficiency and therefore not understanding the terminology
- Commitment of investor could be identified as important factor for keeping up with project aims
- Trust within team

On the contrary, the large number of planning-team participants or lack of project management were not seen as problematic.

As general problems were stated the insufficient training of students and professionals for the subject of sustainable or energy efficient planning, especially problematic being graduate architects, as well as complete lack of innovative HVAC (heating-ventilation-air conditioning) engineers in Austria (partially due to lack of formal education).

As final result of Co_Be a 3 Module Guideline should be developed, for:

- *Planners:* methodology for efficient, interdisciplinary planning process in form of flow-charts, check-lists and operation- recommendations
- *Investors:* demonstration of IP benefits through qualitative and quantitative analysis, simulation of cost and benefits
- *Public Policy* – development of incentive schemes for IP, increasing of awareness

The Guidelines will be complemented with catalogue presenting BEEB-research results, including plan and photo material, building performance data, flow charts on project team structure and project history, POE-results and conclusions from interviews for visualisation of the objectives on practical examples.
Finally, a platform for life-cycle oriented Integrated Planning approach should be formed, serving for information and communication of stakeholders such as planners, investors, clients, users, municipalities, public policy, researcher, where a common aim of realisation of sustainable built environment could be followed.

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