

# Gaming for the Energy Neutral Development: A Case Study of Strijp-S

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**Abstract**—This paper deals with stakeholders' decisions within energy neutral urban redevelopment processes. The decisions of these stakeholders during the process will make or break energy neutral ambitions. An extensive form of game theory model gave insight in the behavioral differences of stakeholders regarding energy neutral ambitions and the effects of the changing legislation. The results show that new legislation regarding spatial planning slightly influences the behavior of stakeholders. An active behavior of the municipality will still result in the best outcome. Nevertheless, the municipality becomes more powerful when acting passively and can make the use of planning tools to provide governance towards energy neutral urban redevelopment. Moreover, organizational support, recognizing the necessity for energy neutrality, keeping focused and collaboration among stakeholders are crucial elements to achieve the objective of an energy neutral urban (re)development.

**Keywords**—Energy neutrality urban (re)development, stakeholder behavior, legislation, game theory.

## I. INTRODUCTION

THE Dutch governmental organizations have ambitious plans regarding the energy, e.g. reach a share of 20% renewable energy generation. Moreover, the municipality of Eindhoven wants to be energy neutral between 2035 and 2040. If comparing the ambitions with the current performance (2008), it can be seen that the total renewable energy generation is about 2% (including net import of electricity). Looking at the total energy generation out of sustainable energy sources, including warmth and biomass the total energy generation will be around 6%. About 20% of the total energy use in the Netherlands can be assigned to the built environment, which is a large share of the total energy use. Still a large share of the energy generation in the energy consumption and built environment can be assigned to natural gas (61%) [1]. If the national government wants to achieve its ambitions, a catch up has to be initiated. Therefore, there is a necessity to implement sustainable and/or renewable energy sources and focus on energy neutrality in the built environment.

In 2008, the national government introduced the 'Wet ruimtelijke ordening (Wro)', which replaced the previous act

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on spatial planning, 'Wet Ruimtelijke Ordening (WRO)'. This new legislation was introduced because of the indistinctness in roles in spatial planning processes. Furthermore, municipalities did not have a manner for cost recovery under public law. The new legislation clarifies the roles of participants in the spatial planning processes and gives municipalities more power in these processes including a possibility to recover costs by public law.

The Dutch government has ambitious plans regarding energy. However, the transition towards energy efficiency in the built environment is lacking. In spite of the ambitions of governmental organizations, local municipalities could not govern towards energy ambitious developments. Municipalities had the feeling that they lost their planning powers in land development projects. Since the national government introduced the 'Wro' in 2008, the power position in (re)development process changed. However, stakeholders do not have a clear picture on how the new legislation influences their behavior in energy neutral urban (re)development processes, which leads to the following research question: what is the impact of the new spatial planning act 'Wro', and corresponding acts, on the decisions of stakeholders in energy neutral urban development processes?

The objective of this research is two folded. The first objective of the research is to discuss the new spatial planning act regarding energy neutral ambitions. The second objective is to illustrate the impact of new legislation on stakeholders' decisions in energy neutral urban development processes using Strip-S project as a case study and thereby providing recommendations on energy neutral urban redevelopment processes.

In the following section, the research consists of four parts: theoretical framework, case study, field research and conclusion and recommendation. It starts with developing a theoretical framework on sustainability, energy neutrality, the Dutch spatial planning process and the process of urban development. Next to the theoretical framework, a case study is conducted on Strijp-S, which is a large urban redevelopment project in Eindhoven, the Netherlands. The theoretical framework and the case study are the base for the field research. In the field research a comparison is made between three scenarios: (1) urban redevelopment processes under the old 'WRO', (2) energy neutral urban redevelopment processes under the old 'WRO' and (3) energy neutral urban redevelopment processes under the new 'Wro'. Finally, the conclusions and recommendations on the energy neutral urban redevelopment process will be given.

## II. THEORETICAL FRAMEWORK

According to W/E advisers, a project is energy neutral: (free translation) if there is no annual net import of fossil- or nuclear energy from outside the system's boundary for the building, use and demolition of this project. This means that the energy consumption within the project boundaries is equal to the amount of generated renewable energy within the boundaries of the project [2].

When the above stated definition about energy neutrality is implemented in urban development this results in the following definition. Urban development is energy neutral, if there is no annual import of fossil or nuclear energy from outside the boundaries of the urban area. This means that the energy consumption within the boundaries of the urban area is equal to the amount of generated renewable energy from within the boundaries of the urban area.

### A. The Dutch Spatial Planning Process under the Old 'WRO'

In the Netherlands, spatial planning is organized in all three layers (national, regional and local) of the governmental organization. Traditionally, the municipality has the most power in the spatial planning. However, the national government and the province can influence spatial planning indirectly or even directly. All three levels of the governmental organization develop spatial plans. The national government produces 'Planologische Kernbeslissingen (Pkb's)', the provinces develop 'Streekplannen' and the municipalities develop 'Bestemmingsplannen'. Between these three spatial plans there is no real hierarchy recognizable. Nevertheless the plans of the lower governmental organizations have to fit in the plans of the higher governmental levels.

### B. The Introduce of New Dutch Spatial Planning Act 'Wro'

The 'Wro' became enforced in 2008. However in the 1990s, with the introduction of the 'Vierde Nota voor de Ruimtelijke Ordening Extra (VINEX)' the roles and interest of involved stakeholders changed. Project developers focused on purchasing land strategically, while municipalities lost their power in these processes. These changing roles in the spatial planning were the reasoning for the introduction of a new spatial planning act. Nevertheless, the introduction of this new act took a long time.

### C. Changes in the Dutch Spatial Planning Process

The interest on spatial planning on the three governmental levels remains the same as under the previous act. However, the spatial planning documents per governmental level have been changed. The national government develops 'Structuurvisies' and 'AMvB's' of the national government. The provinces develop 'Structuurvisies' and 'Verordeningen' on provincial level. Municipalities develop 'Structuurvisies' on municipal level and 'Bestemmingsplannen'. The 'Bestemmingsplan' is a juridical binding plan on spatial planning which is tested on the municipal 'structuurvisie'.

The 'Structuurvisie' has been introduced with the new 'Wro', and provides an insight in the future spatial developments of each governmental level. Between the 'Structuurvisies' of each governmental level there is no clear hierarchy recognizable. However, each lower level 'Structuurvisie' has to fit in the 'Structuurvisie' of the higher governmental level. With the introduction of the 'Structuurvisie' at each governmental level, the transparency between policy documents and binding documents is recorded. Fig. 1 gives an overview of 'WRO' and 'Wro'.

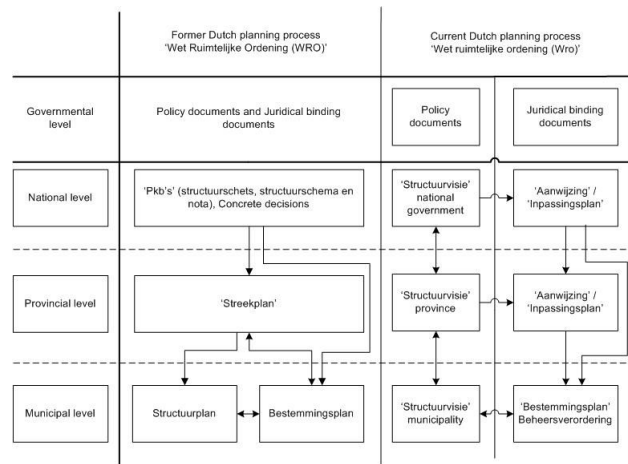


Fig. 1 An overview of old 'WRO' and new 'Wro'

The 'Bestemmingsplan' still is the most powerful steering tool on the municipal level. The position of the 'Bestemmingsplan' and thereby the role of the municipality in the spatial planning process have been strengthened. Next to the introduction of the 'Wro' is the 'grondexploitatiewet (GreX-wet)' introduced, which is part of the 'Wro'. The 'GreX-wet' clarifies the possibilities of cost recovery for the municipality and gives the municipality additional power to set location requirements in the exploitation phase of the development process.

### D. Energy Ambitions and New Legislation

The new legislation regarding spatial planning is introduced to clarify roles in the spatial planning process. However, it is not clear how this new legislation will influence the governing towards energy ambitions in spatial planning processes.

In the 'bestemmingsplan' no specific requirements can be set to achieve energy ambitions because all rules in the 'bestemmingsplan' have to be spatially relevant. Nevertheless, the 'bestemmingsplan' contributes on energy ambitions in the form of the location of buildings regarding sunlight and space reservation for collective sustainable energy facilities.

In the 'GreX-wet', the municipality has a possibility to set location requirements under public law. In these location requirements some requirements on energy can be set, nevertheless, the requirements have to be location-specific and not building-specific.

Since October 2010 the 'Wet algemene bepalingen

omgevingsrecht (Wabo)' is enforced. This act replaces approximately 25 old permits by a single new permit, the 'omgevingsvergunning'. For citizens who strive for renewable energy this permit is a solution, because solar energy is exempted from requesting a permit [3].

#### E. Urban Redevelopment Process

Urban redevelopment processes start out of a local context, in which social development takes place. These developments mostly have a negative influence on spatial quality and/or on the socio-economic function of an area. This process stimulates the political urgency for the (re)development of an area. All stakeholders involved, recognize this situation with threats and opportunities differently and will focus on their own objectives. Comparing and generalizing these objectives into one strategy is difficult but crucial. Then the practical redevelopment starts which may result in a sustainable economic growth in the redeveloped area, so that the local context (which was the initiative to redevelop the area) has been changed.

Therefore, urban (re)development processes are context-driven, and each stakeholder will identify these processes differently and will behave according to its identification and objectives.

#### F. Land Development in the Netherlands

As earlier described, each stakeholder involved has its own objectives in redevelopment processes and will behave according to these objectives. In the Netherlands, municipalities play an important role to govern these processes. Generally, two types of municipal behavior can be identified, an active behavior and a facilitating (passive) behavior. An active behavior indicates that the municipality is actively involved in the process and contributes to the actual development by purchasing land. When the municipality acts passively, it lets private companies take more responsibilities in the land development process. Nevertheless, municipalities will be involved due to their mandatory planning tools in the spatial planning process. Five different land development models [4] can be recognized (Fig. 2), three of them based on an active behavior or the municipality (public land development model, building claim model and joint venture model) and two others based on a passive behavior of the municipality (concession model and private land development model).

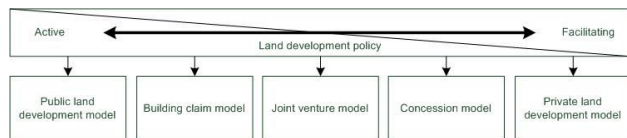


Fig. 2 Five land development models based on municipality behavior

### III. FIELD RESEARCH

Urban (re)development processes are complex, due to the number of stakeholders involved and their behavior to achieve their objectives. In this part of the research, a current urban redevelopment process will be discussed, followed by

modeling stakeholders' decisions in these processes (one model based on the 'WRO' and one model based on the 'Wro'). Thereby three different scenarios will be developed to identify the differences in the behavior of involved stakeholders. The decision models will be developed based on game theory. Game theory is a theory of interdependent decision-making in which the decision-makers involved have conflicting preferences and one part or actor only cannot determine the outcome of their decisions. Therefore, game theory focuses on situations in which interactions and interdependency among stakeholders play a role [5]. In this research the extensive form of game theory model will be applied. Extensive form of game theory is a manner to display the decision-making process by a game tree.

#### A. Process Scheme of an Urban Redevelopment Project

Due to the fact that urban redevelopment processes are highly context-driven, a case study is conducted to get insight in urban redevelopment processes. In this case study, the redevelopment process of Strijp-S is elaborated. Strijp-S is a former industrial area, located near the inner city of Eindhoven (Fig. 3).



Fig. 3 Location of Strijp-S

Since 1891, Philips used the area of Strijp-S for the production of the light bulb and later the television. The area Strijp-S is also known as 'The Forbidden City', because the former industrial area of Philips was only accessible by employees of Philips. The former Philips complex of 27 hectares is currently being redeveloped into a vibrant district with a multifunctional program. On site there are several industrial heritages, which date from the industrial revolution of Philips. Together the industrial heritages result in more than half of the 330.000 square meters existing real estate. Besides the industrial heritages, the area consists of buildings, which have a great symbolic value for the municipality of Eindhoven. The soil of the area is heavily polluted, due to the former industrial function of the area. The planned development of Strijp-S includes a total area of 27 hectares with living area about 285.000 square meters, office space about 90.000 square meters and, commercial and culture facilities about 30.000 square meters

In 2000, the former landowner of Strijp-S decided to leave the area, and initiated the redevelopment of the area by signing

an intention agreement with the municipality. The municipality of Eindhoven and a project developer established a joint venture company (JVC), which purchased the land and became responsible for the redevelopment of this desolated area.

Out of the gathered information of Strijp-S a process scheme (see Fig. 4) of the current redevelopment process of Strijp-S is developed. In the process scheme, the process steps are set out over a period on the x-as. On the y-as are the involved stakeholders, the developed main products and

juridical products and the applicable laws and regulations set out. In the process scheme the concern of each stakeholder in the different steps are visualized. Thereby, the applicable laws and regulations are linked to the products or concern of the stakeholders in the scheme.

The thread of the redevelopment of Strijp-S followed a Joint venture model (PPP), based on a collaboration between the municipality and the project developer, including a building claim for the project developer. The thread of the redevelopment process is described below.

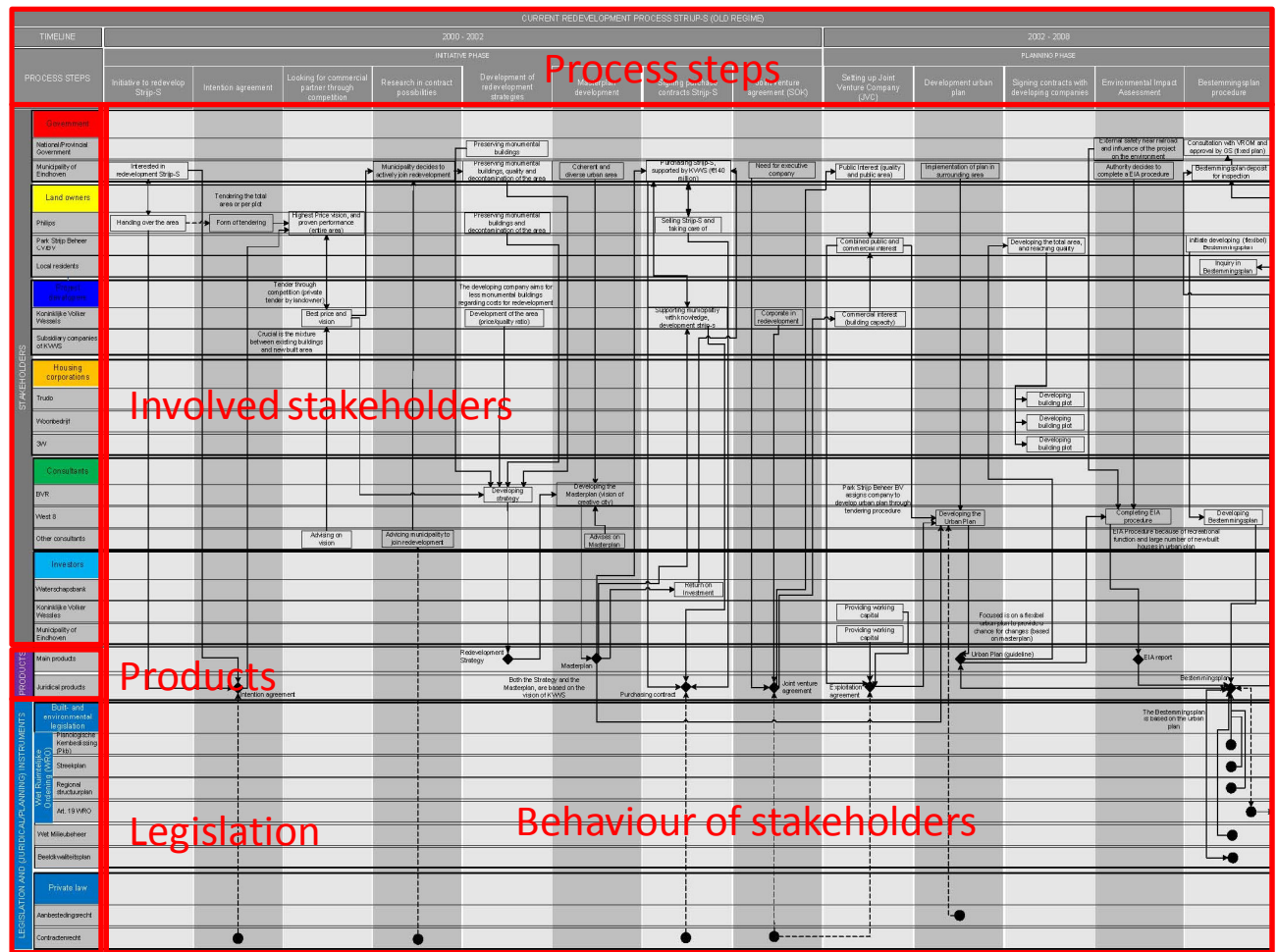


Fig. 4 Process scheme of current redevelopment process

1. Initiative to Redevelop Strijp-S

The process scheme starts with the initiative of Philips to move out of the area of Strijp-S. In this phase, the municipality of Eindhoven declares their interest in the redevelopment of the area. The process step is concluded with the signing of the intention agreement between Philips and the municipality of Eindhoven.

2. Looking for a Commercial Partner

The intention agreement between the municipality of Eindhoven and Philips is the base for the selection of a

commercial partner. Philips selects the commercial partner by a tender, which focuses on a combination of price and vision of the project developer. VolkerWessels wins the tender procedure, due through their vision on the area. With the selection of the commercial partner, VolkerWessels has restrained that they, or a subsidiary company of them, will take care of all building activities in the area.

### 3. Development of Redevelopment Strategies and Master Plan

The municipality gets involved in the redevelopment of the area and starts, together with Philips the development of redevelopment strategy and master plan. The developed strategy and master plan are based on the plans of VolkerWessels.

### 4. Signing Purchase Contract

After the completion of the master plan, VolkerWessels and the municipality of Eindhoven decide to purchase the area of Strijp-S, including the real estate, for €140 million. Philips will be responsible for the decontamination of the area, due to the size of the pollution. Striking in the purchase contract is that the municipality of Eindhoven totally finances the purchase price of the area.

### 5. Joint Venture Agreement and Setting Up a Joint Venture Company

Next to the sign of the purchase contract, the municipality and VolkerWessels sign a joint venture agreement, in which the collaboration is recorded. This joint venture agreement is followed by setting up a joint venture company, called Park Strijp Beheer (PSB). Park Strijp Beheer is the new landowner of the area of Strijp-S.

### 6. Development of the Urban Plan

The master plan earlier developed is the base for the development of the urban plan. Because of the duration of the redevelopment of Strijp-S is the urban plan not strict. The urban plan will be used as guideline for further developments on Strijp-S.

### 7. Signing Contracts with Development Companies

During this process steps, all building blocks are sold to subsidiary companies of VolkerWessels. They are responsible for the redevelopment of those building blocks. However, the developments have to fit in the rough urban plan developed in an earlier period. PSB will supervise whether the prescribed quality is reached.

### 8. Environmental Impact Assessment (EIA) and Zoning Plan Procedure

Due to the size of the site, an EIA has to be fulfilled, followed by the zoning plan procedure. Those two procedures are stated as last two phases within the process scheme, however, the preparation for these two phases started earlier. Eventually the zoning plan procedure took a long time, resulting in a long planning phase.

#### *B. Development of Game Theory Models*

Game theoretic modeling becomes more and more important in recent researches on stakeholder behavior in urban (re)development processes. However, only a few researches make use of extensive form of game theoretic modeling. Samsura, et al. [5] makes use of this modeling method and their work provides good references for this research.

Based on the theoretical framework and the previous

developed process model two game theory models have been developed. Game theory model 1 is based on the decisions of stakeholders in urban development processes under the old 'WRO' (Fig. 5), and game theory model 2 is based on the decisions of stakeholder in urban development processes under the new 'Wro' (Fig. 6).

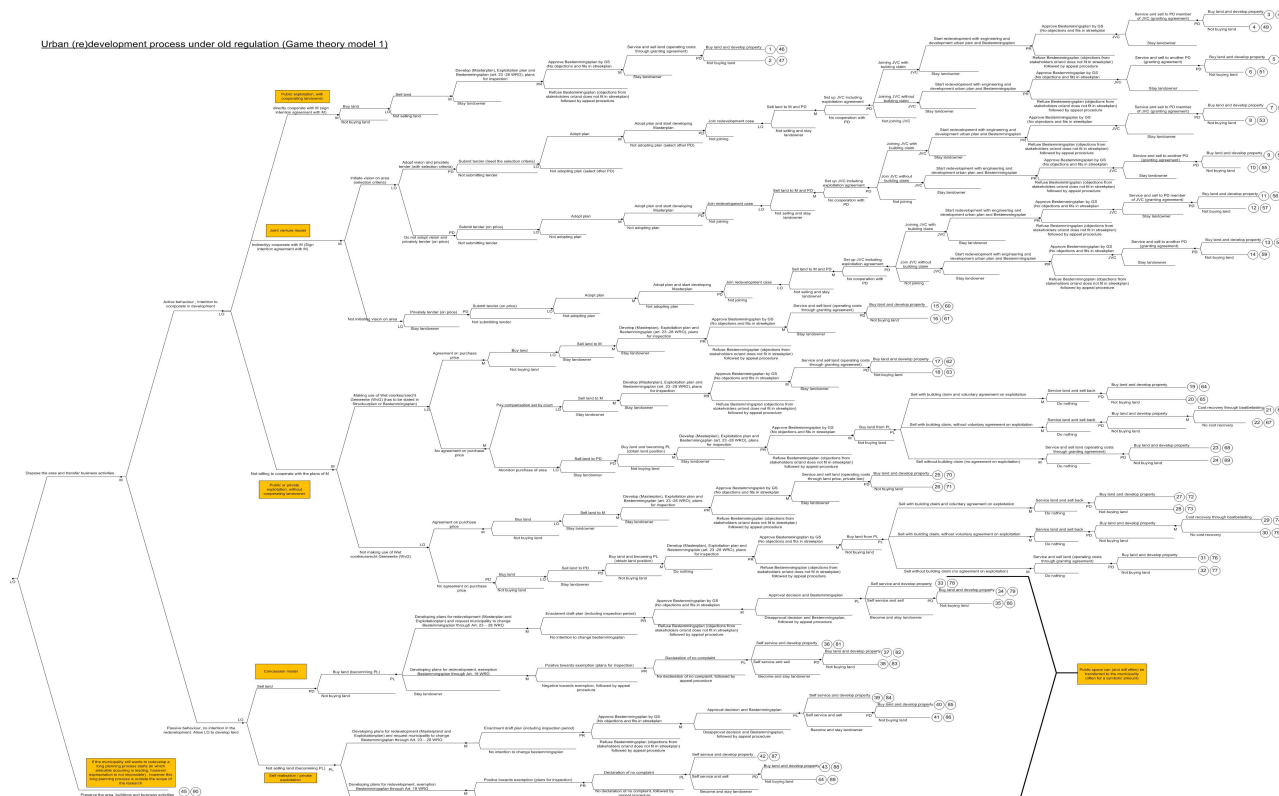


Fig. 5 Game theory model 1 – ‘WRO’

1. Players

Three stakeholders have the largest influence in urban redevelopment projects, namely the landowner (L), the municipality (M) and the project developer (PD). These three stakeholders are the players involved in the game theory models. Their decisions in the process will have the greatest influence on the outcome of the process.

2. Outcomes

The possible outcomes in the games are derived from the land development models out of the theoretical framework and the development of the process model. In game theory model 1, 45 outcomes are defined, and in game theory model 2, 47 outcomes are defined. The differences are due to the implemented new legislation.

3. Payoffs

To identify strategies (the instructions of following up decisions), decisions of players are linked. Each outcome is defined with a combination of decision of each player. Payoffs can be determined when following up decisions of stakeholders are counted.

C. Scenarios

To evaluate the differences in behavior of stakeholders under both acts, three different scenarios are developed:

- Scenario 1: Current redevelopment of Strijp-S (under old ‘WRO’) – “Reality”

- Scenario 2: Current redevelopment of Strijp-S, with an energy neutral ambition (under under old ‘WRO’) – “Reality+”
- Scenario 3: New redevelopment of Strijp-S, with an energy neutral ambition (under new ‘Wro’) – “New+”

The behaviors of the stakeholders involved in the redevelopment process are prescribed per scenario. The differences in behavior can be traced back in the energy neutral ambition of the municipality in scenario 2 “Reality+” and scenario 3 “New+”.



Urban (re)development process under new regulation (Game theory model 2)

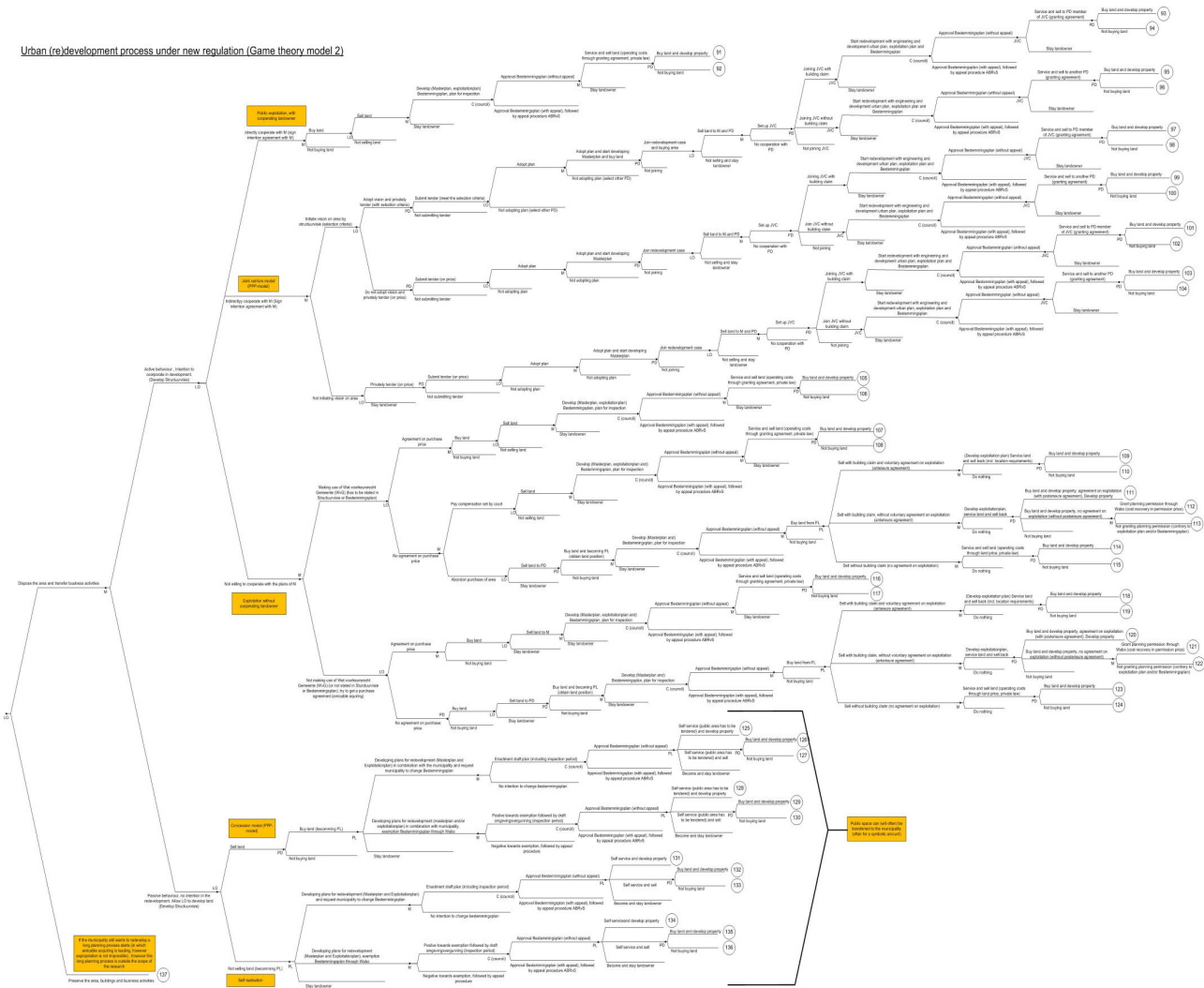


Fig. 6 Game theory model 2 – ‘Wro’

*D. Scoring Decisions*

In total nine experts that represent three types of stakeholders scored each decision on the aspects (spatial) quality, finance and process time, with in mind the prescribed behavior per scenario.

First, decisions in the process will be weighted on three aspects; (spatial) quality, finance and process time. Each stakeholder will have different objectives in land and property development, so each stakeholder will weight these aspects differently. These aspects have to be scored in percentages by experts illustrating the preferences between the aspects (with a total of 100%). Each type of stakeholder will have different sub-variables, based on threads in the game theory model, which are elaborated in Table I.

Second, each player involved in the game received a list with decisions, which have to be made during the process. All decisions are labeled with an ID number (from 1 to 293). The player scores each decision on the three scoring aspects, with figures between -10 (very negative) and 10 (very positive)

with 0 as no effect. This is done for all three developed scenarios. Scoring the decisions is based on preferences between decisions.

TABLE I  
VARIABLES PER STAKEHOLDER

Player	Variables
Landowner (L)	(1) Transfer business activities
	(2) Selling land
	(3) Tender procedure
	(4) Self realisation
Municipality (M)	(1) Implemented plan
	(2) Giving building claim
	(3) Land policy
	(4) Buying land
	(5) 'Bestemmingsplan' procedure
	(6) Servicing land
	(7) Cost recovery
	(8) Tender procedure
Project developer (PD)/(PL)	(1) Opportunity to develop property
	(2) Having building claim
	(3) Buying raw land
	(4) Buying serviced land
	(5) Selling raw land
	(6) Selling serviced land
	(7) Servicing land
	(8) Land policy municipality
	(9) 'Bestemmingsplan' procedure
	(10) Cost recovery by the municipality
	(11) Tender procedure

Third, the overall payoff of the decision for the stakeholder is the product of the weights of the aspect by the scores of the decision on the three aspects (spatial quality, finance and process time).

### E. Findings

This part of the paper shows the findings out of the game theory models.

#### 1. Scoring Aspects

Each player focused on different aspects, and the aspects were weighted differently per scenario (Table II).

TABLE II  
STAKEHOLDERS SCORING ASPECTS PER SCENARIO

		Landowner	Municipality	Project developer
Scenario1 Reality	(spatial) quality	10%	48%	42%
	Financial	55%	32%	35%
	Time	35%	20%	23%
Scenario2 Reality+	(spatial) quality	10%	68%	52%
	Financial	55%	15%	31%
	Time	35%	17%	18%
Scenario3 New+	(spatial) quality	10%	68%	52%
	Financial	55%	15%	31%
	Time	35%	17%	18%

The landowner is focused on the financial aspect, and spatial quality is not that important. Thereby process time is another important aspect, which is closely related to the financial aspect.

In scenario 1, the municipality focuses on the spatial quality, as well as the financial aspect. In scenario 2, the municipality lowers their interests in the financial aspect and focus even more on spatial quality, because the municipality has an energy neutral ambition.

Scoring the aspects was the hardest task of the experts of the project developer, because there is a strong link between all three aspects. The spatial quality is of great importance, because a good spatial quality will result in financial benefit.

However, time process is also strongly linked to the financial aspect. The 10% difference on spatial quality between scenario 1 and 2, can be assigned to the indirect influence of the energy neutral ambition of the municipality.

#### 2. Maximum Payoffs

The maximum payoff indicates the best outcome for the stakeholder involved. The stakeholder will strive to follow the pattern out of the game tree to come to the outcome, also known as following a strategy to maximize the utility. Each stakeholder has his own preferred outcome, and thereby preferred strategy (as shown in Fig. 7).

The landowner will follow the following strategy to achieve his objective. The redevelopment starts with the intention of the landowner to leave the area. Thereinafter, the land of the landowner will be sold to a combination of the municipality and project developer in a joint venture model (PPP-construction), with a tender procedure on price. This is due to the financial focus of the landowner.

The municipality follows the subsequent strategy to achieve his objective. The municipality focuses on an active behavior, in which it buys land from the landowner, together with the project developer. The project developer is selected by a tender procedure with selection criteria. Thereinafter, a joint venture company is set up between the municipality and the project developer. However, for the municipality it is better not to provide a building claim within this structure, but to sell serviced land to other project developers. A lot of risk for the municipality will be involved in this scenario, because no buyer is guaranteed. On the other hand, no project developers will join the joint venture company without a building claim.

The project developer follows the following strategy to achieve its objective. The project developer wants to get involved in a joint venture company including a building claim. The project developer is selected by making use of a tender procedure with selection criteria. The project developer focuses on getting a building claim in the redevelopment process.

#### 3. Sub-Game Perfect Equilibrium (SPE)

A sub-game Perfect equilibrium is the best outcome for all players involved. The SPE can be found by making use of backward induction, starting at the best outcome for the last player in the process, the project developer. The SPE's per scenario with calculated payoffs are shown in Table III.

TABLE III  
SPE PAYOFF PER SCENARIO

Sub-game Perfect Equilibrium (SPE)				
	Outcome ID	Landowner	Municipality	Project developer
Scenario1 Reality	3	12,23	37,38	39,35
Scenario2 Reality+	48	12,00	43,28	39,30
Scenario3 New+	93	11,40	47,27	39,98



In scenario 1, outcome ID number 3 is the SPE, in which each player's strategy is a best response to the other players' strategies. This outcome emerges from the strategy that the landowner decides to leave the area; thereby the municipality behaves actively in the development process. The landowner selects the project developer based on selection criteria, and

the project developer will buy the land, together with the municipality, from the landowner. The project developer and municipality form a joint venture company (JVC), which will be responsible for the redevelopment of the area. The project developer will get a building claim for joining the JVC (illustrated in Fig. 7).

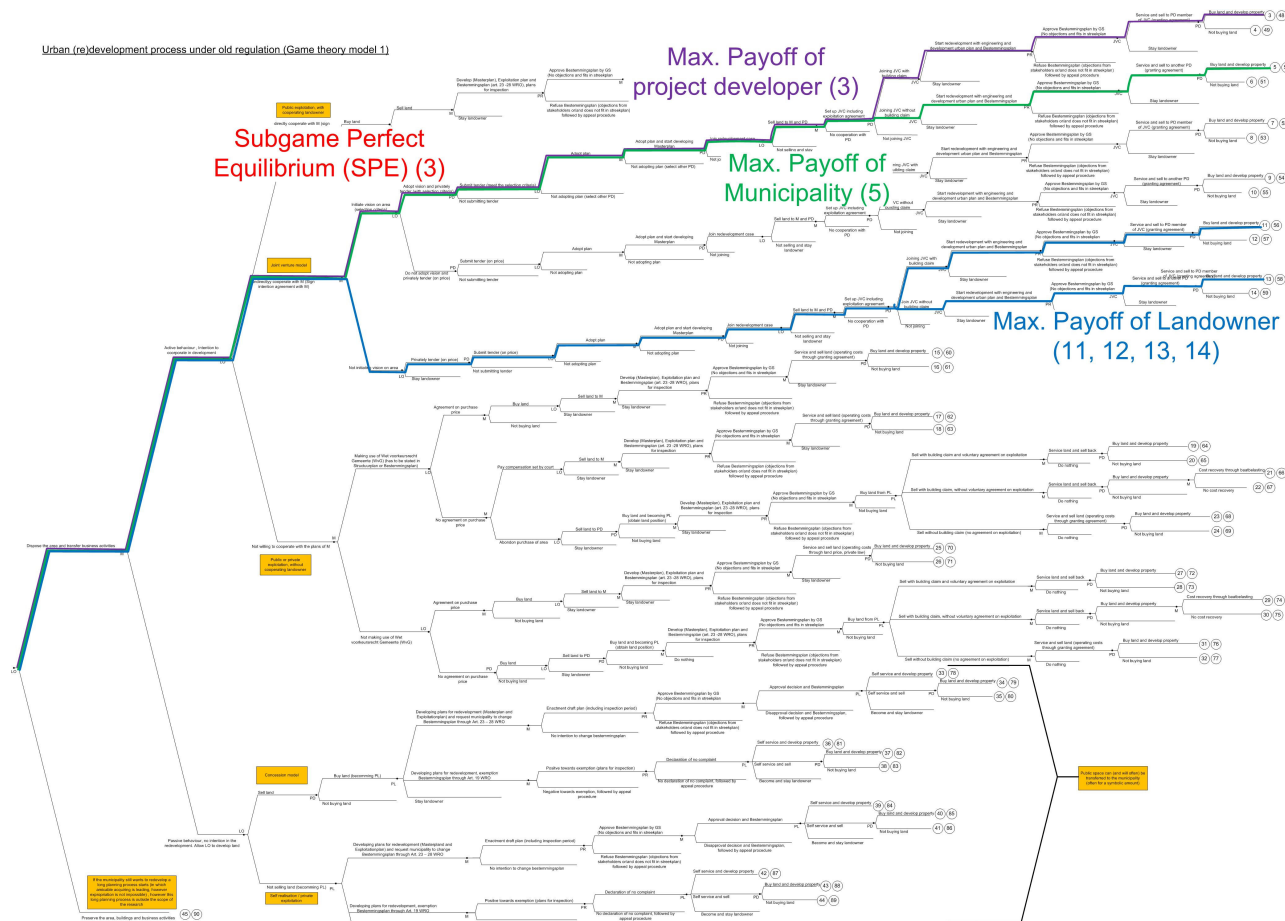


Fig. 7 The illustration of Game theory model 1 outcomes

Obviously, the payoff structure at SPE is lower than every player's best payoff. Particularly, the municipalities' payoff is low, but if the municipality chooses to not provide a building claim within the JVC-structure the project developer decides not to join the JVC-structure. Therefore, the municipality has to apply a building claim. For both scenario 2 and scenario 3, the similar SPE's can be recognized (in scenario 2 outcome ID 48 and in scenario 3 outcome ID 93).

The differences in outcomes reflect the differences in behavior of the stakeholder regarding the energy neutral ambitions and legislation. There are obvious differences between scenario 1 and 2, which could attribute to the energy neutral ambition, while the differences between 2 and 3 are mainly due to the implementation of new legislation.

IV. CONCLUSION AND RECOMMENDATIONS

The new 'Wro' and corresponding acts slightly change the behavior of stakeholders in energy neutral urban development processes. The municipality becomes more powerful and can set location requirements, which may lead to energy neutral areas. Nevertheless, collaboration among stakeholders is the most important aspect to come to energy neutral urban (re)development processes.

A. Municipalities' Behavior in Urban (Re)development Processes

Due to the introduction of the new legislation on spatial planning, the power within the governmental organization has changed. Municipalities became more powerful in the spatial planning process. Especially, the power to test the 'Bestemmingsplan' with the 'Structuurplan' is a shift in

powers between the province and the municipality. Nevertheless, this shift will generate a lot of work for the municipality, thereby raises the question if the municipal organization can handle this amount of work.

Municipalities become more powerful in redevelopment processes, while private organizations become less powerful. Especially in cases in which the project developer owns land, and has no intention in collaborating with the municipality, the municipality can set additional location requirements through the 'exploitation plan'.

Acting passively was under the old 'WRO' not interesting for the municipality, especially in large redevelopment projects with many landowners involved. For municipalities it becomes more interesting to act passively with the introduction of the new legislation.

As municipality becomes more powerful in (re)development processes, it is important that all municipal departments support the same energy ambitions. If municipalities have energy neutral ambitions, it is important that they select the right project developer during the process. Three different types of project developers, with different objectives can be recognized:

- Investor-project developer: this type of project developer usually has a long-term objective because the investment in (re)development projects with the intention to have a long term profit (an example is rental houses). After this long term, the project developer will sell the real estate, and still wants to have a high return on invest. If energy prices keep rising, energy neutral urban areas will become more interesting. Therefore, this type of project developer is interested in energy neutral urban areas.
- Contractor-project developer: this type of project developer usually has a short-term objective, because it aims for building capacity in a certain area. This project developer will sell the area or real estate direct after completion. Energy neutrality will not be the main objective of this type of developer because of the negative or small return on investment.
- (independent-) project developer: this type of project developer is not allied to a contractor or an investor. They will develop the area according the ambitions of the client.

#### *B. Project Developers' Behavior in Urban (Re)development Processes*

With the new 'Wro', purchasing land strategically will become less interesting for project developers because the municipality will have more power in the redevelopment and can govern towards certain objectives. For the project developer, 'Free-rider' behavior will not be possible anymore, at least to the extent this initially appeared. Before the introduction of the 'Wro', some project developers made use of the possibility not to cooperate in (re)development processes (so-called 'Free-riders'). The new legislation will terminate this behavior, due to the possibility to recover costs and set location requirements under public law.

With the introduction of the new 'Wro', acting passively becomes more interesting for the municipalities. However, a passive behavior of the municipality becomes less interesting for project developers. Nevertheless, collaboration with the municipality will be of even more importance. The project developer needs the municipality's planning power during the planning process of the project. The municipality becomes more influential while behaving passively; therefore, it is for project developers important to collaborate with the municipality.

#### *C. Landowners' Behavior in Urban (Re)development Processes*

Through the introduction of the new legislation, it becomes more interesting for a landowner to develop its own plot because the simplified and shortened spatial planning process. Nevertheless, it is not clear how often this will occur in urban redevelopment processes.

When municipalities focus on energy neutrality, the landowner might believe that the revenues of the land become less high, because the municipality will focus more on the spatial development than on the land prices.

#### *D. Recommendations for Energy Neutral Development*

When focusing on the energy neutral urban redevelopment process (Fig. 8), the following recommendation can be made:

- In the initiative phase of the process, the municipality has to point out their ambition on an energy neutral redevelopment. This ambition can be recorded in the "Energie Prestatie op locatie" (EPL). Moreover, political support within the municipal organization for this ambition is crucial.
- Municipality should develop the urban plan and the 'Bestemmingplan' with the energy neutral ambition in mind. During the strategy and master plan development phase, the energy neutral ambition has to be elaborated and recorded.
- When looking for a commercial partner in the redevelopment process one should be aimed on an experienced partner and a partner who is willing to strive for the same energy neutral ambition.
- In the process of setting up a joint venture company (JVC) it should be focused on a voluntary agreement on exploitation, including location requirements on the energy ambition.

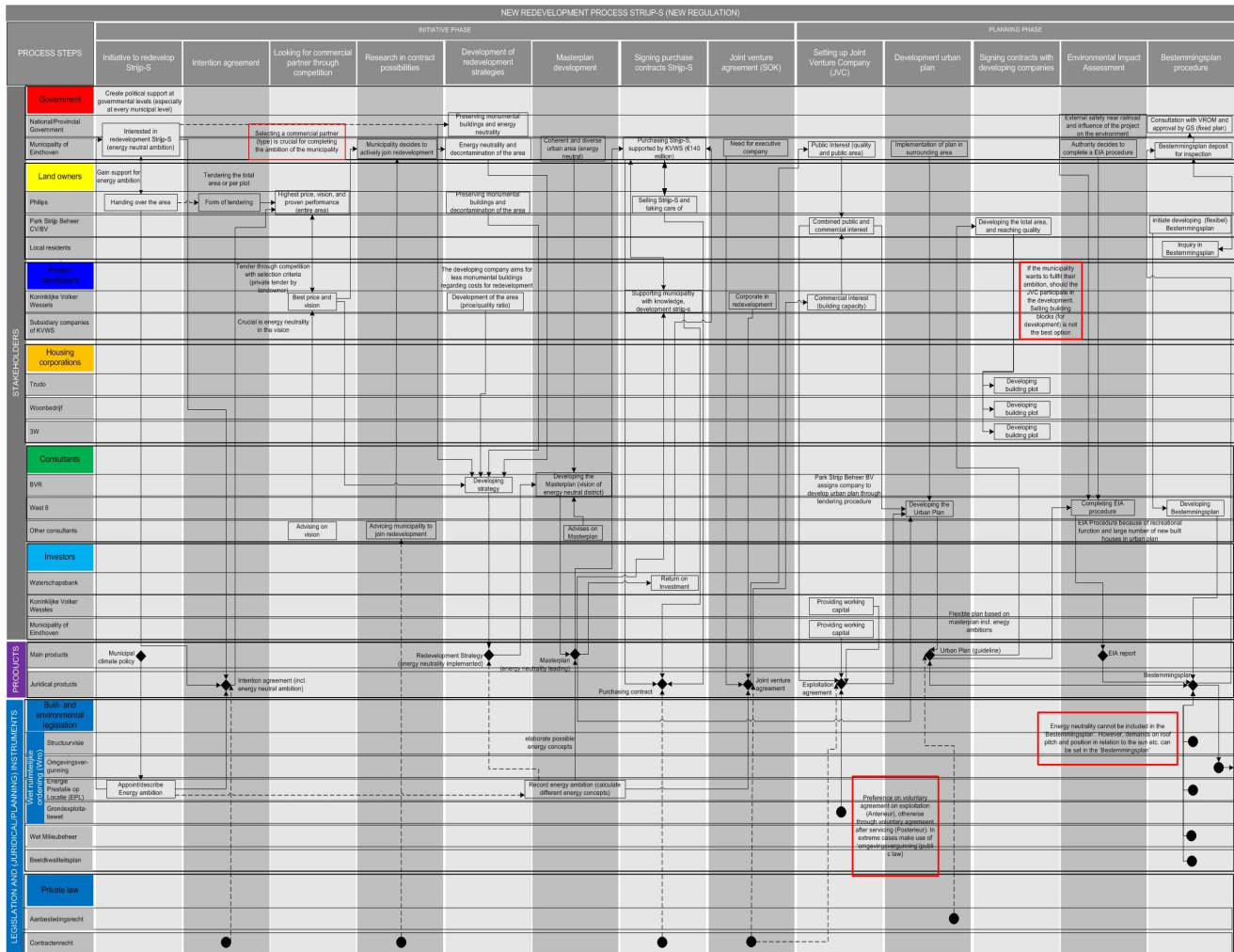


Fig. 8 Process scheme of redevelopment under Wro

E. Recommendations for Future Research

In this paper, the decisions of stakeholders in urban redevelopment processes under old act 'WRO' and new act 'Wro' are visualized. This is done by making use of extensive form of game theory. The two most remarkable limitations are that (1) urban redevelopment processes are very context-driven and therefore hard to generalize, (2) because of the complexity of urban redevelopment processes there may be other legislation influencing the decisions of stakeholders. Out of these two limitations, suggestions for further research can be defined:

- The application of gaming in urban redevelopment processes may be a solution for evaluating decisions of stakeholders in (energy neutral) urban (re)development processes. By gaming, all stakeholders involved will be present a simulation of the process, where the stakeholders involved can directly respond to each decision of any other stakeholder involved.
- As the process of urban redevelopment processes and the decisions of stakeholders may be influenced by other

legislation, the game theory models can be expanded with additional legislations. Moreover, the possible strategies for the municipalities if landowners are not willing to collaborate in the redevelopment may be implemented in further research.

- More research can be carried out using the game theory models and process models developed in this research as starting point. With some modifications, these models can be applied in other (re)development projects.

REFERENCES

- [1] TU Delft, Delft Energy Initiative; KIVI NIRIA Stuurgroep Energie. (2010). De energievoorziening van Nederland vandaag (en morgen?). Arnhem: KIVI NIRIA.
- [2] W/E adviseurs. (2009). Stevige Ambities, Klare Taal! Definiering van doelstellingen en middelen bij energieneutral, CO2-neutrale of klimaatneutrale projecten in de gebouwde omgeving. Utrecht: Creatieve Energie, EnergieTransitie.
- [3] van Middelkoop, L. (2010). Meer wortels en stokken: duurzame energie en energie-efficiëntie in de (bestaande) gebouwde omgeving. In U. v. Centrum voor Milieurecht, Duurzame energie - Juridische kansen en belemmeringen (pp. 97 - 148). Groningen: Europa Law Publishing.

- [4] Deloitte. (2007). Gemeente Governance Grond(ig) beleid - Grondbeleid, grondexploitatie en grondbedrijven grondig bekeken. Rotterdam: Deloitte.
- [5] Samsura, D., van der Krabben, E., & van Deemen, A. (2010). A game theory approach to the analysis of land and property development processes. *Land use policy* 27, 564 - 578.