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Strategic real options in area development projects: Reflections on the Finnish background

ABSTRACT

Area development projects are large building projects that aim for relatively large areas to be constructed in a concentrated time frame. Finnish municipalities have tended to favor area development projects due to the related, normally positive, indirect cash flow effects for municipalities, e.g., positive tax income effects, and the fact that they speed-up the municipal development. Area development projects, however, also include economic risks to the municipalities, e.g., caused by changes in the population demographics in the developed areas that change cash flows adversely. As most municipalities in Finland are facing tight financial times (AD 2009) they may be very risk averse. This may cause them to be reluctant to favor the start of new area development projects, which again delays municipal development, and may even delay growth on the aggregate level.

This paper describes the traditional (present) area development policy model of the Finnish municipalities and discusses the creation of possible new policies through an analysis of high level (strategic) real options available to municipalities to change their role in these projects. The extension of the municipalities' involvement in the area development projects can help in reducing municipalities' economic risk level and may be used in maximizing returns.

Key words: *Area Development, Municipalities, Real Options, Risk Management, Decision Support*

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1. INTRODUCTION

1.1. Background

Area development projects are multi-million euro construction projects that aim for relatively large areas (within municipalities) to be constructed in a concentrated time frame, i.e., community planning projects. The projects have been popular among Finnish municipalities, because they normally tend to have positive indirect cash flow effects for municipalities, e.g., positive tax income effects, and the fact that they speed-up the municipal development. The projects can most often be divided into three separate phases according to the conducted activities: planning and zoning, construction, and post-construction.

Planning and zoning phase is the first part of the area development process that includes the investment of un-zoned land to the project (ear marking the land for the project), planning the area to be developed (architecture, municipal engineering & infrastructure plans etc.), and zoning of the area. Construction starts after the zoning is ready and the construction permits are valid, the phase includes the construction of the municipal engineering & infrastructure into the area (roads, pipelines etc.) and the construction of the buildings themselves. Post-construction phase starts after the construction of the buildings is ready, the phase includes "owning" the buildings and maintenance of the municipal engineering and infrastructure constructs. For municipalities the post-construction phase also includes service provision obligations for the inhabitants of the developed area, e.g., kindergartens, schools etc.

Area development projects cause economic risks to the municipalities in all the different stages of the projects; most importantly and notably in the construction and post-construction phases, in the form of possible cost overruns in construction and as costs caused by changes in the population demographics in the already developed areas. Demographic changes may cause negative changes in the municipalities' earnings in forms of, e.g., increase in the need and cost of municipal services (municipal child care, healthcare, seniors' services etc.) and diminishing municipal income tax yields from the area (adverse selection of inhabitants, ageing population). These economic risks may cause a cash bleeding effect for the municipality that may be impossible to counterbalance from within the developed the area. These issues should be taken into consideration, but the ex-ante financial analysis of area development projects is made difficult by their long economic life that has the tendency to render the estimation of the far ahead development project cash-flows inaccurate. Financial risk is usually defined as deviation from the expected value of, e.g., a future cash flow, in this paper, when economic risk and financial risk are referred to we mean a negative deviation from the expected, negative in the sense that the agent in question is worse off than expected.

Area development in Finland started on a large scale after the mid-1960's, when unprepared

cities, mainly in the South of Finland, experienced a wave of job related migration. It became critical to be able to offer the migrants that were coming to work in the cities, new housing fast. This need boosted the start of a number of large scale area development projects in Finnish cities (Eerolainen, 2005). Some of the largest of these projects are still, 40 years later, partly under construction. As times have changed and most municipalities in Finland are facing tight financial times they have become more attentive to economic risks and may be very risk averse. This may cause, and probably has already caused some municipalities not to favor the start of new area development projects. This can delay municipal development, and may even affect growth on the aggregate level.

Data from the Finnish Association of Municipalities (Kuntaliitto, 2008a) shows that more than 70% of Finnish municipalities' spending is used on social & health services and educational & culture services, and that the spending (costs) of municipalities have risen in the last ten years on average at about a 5% per year rate. At the same time an average of about 25% of municipalities operational (service provision) costs have been covered by operational income and the rest has been financed from income from different municipal taxes (personal, corporate, and tax on land) and from state subsidies. The average solidity of Finnish municipalities has remained at a relatively high level, but the average indebtedness has slowly increased (Kuntaliitto, 2008b).

When a new area is developed and constructed within a municipality it is, in the light of the available statistics, likely that the income received by the municipality from the area will not be able to fully cover the operational costs arising from the area without the subvention from other municipality income, or external financing. Furthermore, the growing burden on municipalities from the rapidly aging population (municipalities are obligated by law to furnish certain services) will be likely to cause new stress on the municipalities' economy, which will leave less room for large infrastructure investments in the future; this will be likely to reflect negatively on area development projects that require large investments from the part of the municipalities.

The averages do not reveal the whole truth, as there are municipalities with booming economies and less problems in sight, but on the other side of the coin there are municipalities that are much worse-off than the average. In Finland the division between the well-off and worse-off municipalities is mainly between large population centers doing better (with some notable exceptions) and more sparsely populated municipalities, mainly situated in the North and in the East of Finland, doing worse. The tendency to avoid further economic risks and large investments (binding of capital), brought by, e.g., area development projects, is probably already the prevalent state in many of the worse-off municipalities. What, however, remains the same for all municipalities is the possibility of economic risks from area development, and the fact that if these risks start materializing it will be highly likely to cause a slowdown in (area) development within the municipalities.

At present, the economic risk level of area development to municipalities is to a large extent, the result of the traditional (and presently used) policy model of involvement of Finnish municipalities in these projects; the traditional policy is followed, even when it is not economically the best possible, or even a profitable strategy of involvement. Because the economic risk level is the result of a chosen policy, and not of the inherent nature of area development projects themselves, the economic risk level can be affected by changing the policy. By selecting a policy that is analyzed to be the economically best, or at least a profitable policy (strategy), the economic risk level can be better managed, and even significantly lowered. In the re-evaluation of the municipalities' policies, the mapping of strategic real options available to municipalities' involvement in area development projects plays a pivotal role. The strategic level real options are the building blocks from which area development strategy is built. The strategic level real options are defined here as the different strategic choices the municipalities have with regards to their involvement in area development projects, e.g., if the municipality wants to sell the land allocated for an area development project after zoning or not; the land can be sold, but it does not have to be sold. This is a strategic real option that the municipality has. Each strategic choice has a unique economic impact on the municipality. Operational real options are similar choices and flexibility that the municipality / managers have on the operational level.

The municipalities should select the best area development project involvement strategy available. Considering the economic viability of the municipality, the selected strategy should be such that the project is profitable for the municipality, i.e., an involvement strategy with the a profitable combination of strategic level real options. The optimal solution would be a strategy that fulfils all the policy objectives of the municipality and gives the highest profitability doing so. Profitability is on only one measure of success for area development projects, however, it is often very important for municipalities; unprofitable projects cannot be accepted, when finances are tight, even if they would bring wealth measured by other means than money. In this paper we concentrate on discussion of profitability of area development projects for municipalities.

Real options are finding their way to the toolkit of many managers, however, they still are a rather new issue in capital budgeting. Using real options is not very common. even in large corporations (Ryan & Ryan, 2002). This gives a reason to believe that use of real options has not spread among the decision-makers responsible for area development projects in Finnish municipalities. Real option valuation can be used for numerical analyses of project profitability, the most commonly used valuation methods are the Black-Scholes option valuation method (Black & Scholes, 1973) and the binomial option valuation model (Cox et al., 1979). There are also newer real option valuation methods that have been designed to be easier to use in real world applications, e.g., the Datar-Mathews method (Datar & Mathews, 2004; Mathews & Datar, 2007) and the fuzzy pay-off method (Collan et al., 2009b). This paper does not concentrate in valuation of

real options, but focuses on how area development investment strategy can be understood as a combination of strategic level real options.

Before we go to the mapping of real options in area development projects, let us first present the traditional policies municipalities have adopted for their involvement in area development projects in Finland.

1.2. The Traditional Role of Finnish Municipalities in Area Development Projects

The most active involvement of Finnish municipalities in area development projects has traditionally been quite concentrated on the *planning and zoning phase* of the projects. Municipalities have traditionally been involved as the owners of un-zoned land, partly or fully making the basis for the to-be-developed area, and as the zoning authority, see, e.g., (Anonymous, 2004; Törmänen, 2004). The municipalities have also traditionally carried the bulk of the responsibility of the planning of the area development projects, especially for the part of planning the municipal engineering and infrastructure. The actual architectural planning has not often been done by the municipalities, however, they are the acting regulating authority for the architecture. Finnish municipalities are the zoning authority in their own territory, which means that the municipalities have a zoning monopoly.

From the point of view of the Finnish municipalities, the planning and zoning phase is usually not cash outflow intensive, as the municipalities are owners of (part, or all of) the land allocated for the project and will invest the land to the planning and zoning phase. The planning and zoning cost cash flows for the land owned by the municipalities themselves are usually relatively small from the point of view of the whole area development project. By zoning land the municipality takes on the responsibilities of building the municipal engineering & infrastructure and the furnishing of the municipal services.

It is usual, especially in larger population centers that the municipalities are buying all the un-zoned land they can purchase. Furthermore, the municipalities in Finland have a law given right to redeem private lands for their purposes (zoning), however, this right is seldom exercised. The purpose of the law is to prevent speculation with land value and by speculation hindering municipal development. At the end of the planning and zoning phase the Finnish municipalities most often select to sell or to lease their (now zoned) land and will exit from the ownership position in the area development process (policy of exercising of the option to abandon).

When zoning other land owners' un-zoned land municipalities have (after a change in the Finnish Law) been able to prioritize zoning of areas where the land owners agree to a contract on land use (Fin: Maankäyttösopimus). These contracts most often stipulate that the land owners', whose land is zoned agree to pay for the costs of the obligations that municipalities have on

building the municipal engineering & infrastructure to the zoned area. According to the Finnish law on land use and construction (91f§) the maximum possible payment required for the zoning is 60% of the added value caused by the zoning.

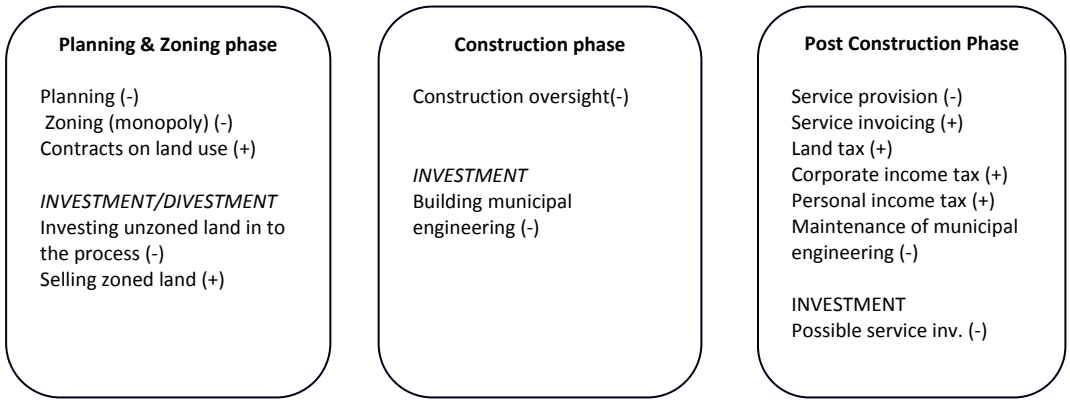

FIGURE 1. The three phases of area development with the traditional type of Finnish municipalities' involvement at each stage. Cash flow information –/+ at each stage for Finnish municipalities and required investments.

This means that land owners who do not agree to contracts on land usage will not see their land zoned, because the municipalities cannot afford to and will not pay for the building of the municipal engineering & infrastructure on such lands (Eerolainen, 2005). Effectively this means that municipalities can force costs of municipal engineering & infrastructure on land owners, who are the actual beneficiaries. When zoning their own land the costs of municipal engineering & infrastructure are transferred in the sales or leasing price of the municipalities' land.

Traditionally the *construction phase* of area development projects has included the municipalities' investment into constructing the municipal engineering & infrastructure to the zoned area and acting as the construction oversight authority (building permits etc.). The municipalities very seldom act as builders, however, building of facilities for municipal services (schools etc.) are the exception to the rule.

In the *post-construction phase,* the municipalities will act as the provider of municipal services, for which they will obtain some fees; it is previously noted that the services' fees cover on average about 25% of the municipal service provision. The municipalities receive tax income from the developed areas in the form of municipal tax on personal income (in 2008 rates varied between 16,00% and 21,00%, with the average at 18,00% on taxable income (Verohallitus,

2007)), the part of the tax on corporate income collected by the state and paid to municipalities, and the municipal property tax (in 2007 rates varying, depending on the type of property and set yearly individually by municipalities, between 0,22% for residential housing and 2,20% for nuclear power plant properties, calculated from the taxable land value set by the authorities (Verohallinto, 2007)). The tax income is used to finance the municipal economy, i.e., including the gap between municipal service provision in the developed areas and the maintenance of the municipal engineering, including the infrastructure investments (roads etc.). In case there is the need to build new service facilities, or to make other new municipal investments in the developed area in the post construction phase the municipalities have, more often than not, ended up paying for these investments fully. The traditional involvement of the Finnish municipalities in area development projects, phase by phase, is illustrated in figure 1.

Finnish municipalities have traditionally required a very low return of the invested capital in the area development projects (municipal engineering & infrastructure investments), close to the risk free interest rate, or sometimes even so that no actual return on the investment has been required, see, e.g., (Korkman, 2008) and (Kaleva & Leiwo, 2006). The economic analysis and the investments have often been made based on the assumption that tax income streams are risk free, which has been reflected on the discount rates; if economic analysis has been made regarding the return from these investments.

1.2.1. Some Identified Economic Risks in the Traditional Involvement of Finnish Municipalities in Area Development Projects

The area development projects are not without economic risk to the municipalities, even if they tend to require very low (risk free) return on their investments into these projects, on the contrary: a number of economic risks can be identified in the traditional policy of involvement of the Finnish municipalities in area development projects. The economic risks are mostly related to the uncertainty about the eventual economic outcome of the project. The uncertainty is caused by the inaccuracy of expectations about the size of the identifiable future cash flows. This makes analysis difficult, luckily the most important sources of economic risks from area development projects can most often be identified (ceteris paribus, non-identifiable risk would be even worse). The problems with estimation inaccuracy are accentuated by the fact that area development projects are long-term projects, with very long economic lives and with long planning and construction times. The information and estimations used in the profitability and feasibility analyses of area development projects most usually come from the individuals employed by the municipality, i.e., the information is in the form of expert opinions. Probably the single most important uncertainty and economic risks come in the form of the difficulties to estimate the costs of municipal engineering & infrastructure: cost overruns in infrastructure investments in general are

notoriously well-known. For some examples on spectacular cost overruns on public infrastructure investments see, e.g., (Flyvbjerg et al., 2003). Flyvjbjerg also presents and models how economic risks can be assessed in public projects.

Starting on the economic risks in the temporal order of the area development projects we concentrate first on the municipalities' economic risks in the *planning & zoning phase*. On the revenue side the uncertainties (economic risks) concentrate on the income that can be received after the zoning by selling, or leasing the land municipalities own. This economic risk may not be very "important", as zoned land value tends on average to rise constantly in Finland (Tilastokeskus, 2008a). The risk on not receiving the payments agreed on in land use contracts is relatively low, due to the fact that there usually is a consensus on the matter, and it may not be in any of the parties' interests to litigate. Furthermore, the payments may be required partly in advance, which further decreases the economic risks for municipalities. On the cost side the economic risks are not very significant, as the planning and zoning costs are not very large in relation to the size of the area development projects, or even in absolute numbers.

TABLE 1. Some identified economic risks from the traditional type of Finnish municipalities' involvement in area development projects. (Importance of the risk (our estimate) in parenthesis on a scale 1–5; where 5 most important)

	Revenue Related Risks	Costs Related Risks
Planning & Zoning Phase	**Sales price of zoned land not as expected (2)** **Contracted land use payments not as expected (1)**	**Planning cost not as expected (1)** **Zoning cost not as expected (1)**
Construction Phase		**Municipal engineering & infrastructure cost not as expected (5)**
Post Construction Phase	**Personal municipal tax income not as expected (4)** **Municipalities' part of the tax on corporate income not as expected (3)** **Service revenues not as expected (2)**	**Service provision (need) costs not as expected (4)** **Maintenance costs not as expected (3)** **Possible unexpected municipal investments to the area (4)**

Economic risks in the *construction phase* of the area development projects tend to be larger than in the planning & zoning phase, this is caused by the need to invest in the construction of municipal engineering & infrastructure and the ensuing risks of cost overruns. The economic risk of cost overruns is very tangible, as the costs of municipal engineering & infrastructure tend to change constantly, and the speed of change varies (Tilastokeskus, 2008b). When area development is planned, the actual construction of infrastructure may still be years away; if the pricing of the

municipalities' zoned land for sale or for lease, is done, e.g., years before the actual construction begins, there is a risk that the income obtained will no longer be able to cover the construction costs (that usually have been the basis for the pricing of the land). This means that any costs over the (perhaps years before) budgeted costs may cause a negative economic result from the point of view of the municipality. Naturally such costs can be contracted in advance, however, it is not very likely that contractors are ready to enter into forward agreements regarding construction years ahead. So the economic risk faced with the municipal engineering and infrastructure costs is coming from estimation inaccuracy and as a result, the possibility of erroneous pricing, and from the possibility of unexpected cost overruns even on top of the higher than expected market price of construction.

Post-construction phase economic risks on the cost side include the costs of municipal services reaching unexpectedly high levels, caused, e.g., by unexpectedly high wage increases, maintenance costs of the municipal engineering & infrastructure investments being higher than expected, and from the possibility of an unexpected need for new municipal investments into, e.g., infrastructure or service facilities (e.g., schools, kindergartens etc.). The services' unexpectedly high costs of operation and higher than expected maintenance costs may not be a very large economic risk on a yearly basis in absolute numbers, however, accumulated over the economic life of the project they may be considerable. The economic risks of additional, unexpected, investments into more services capacity, e.g., in the form of buildings and hiring more service staff, is an important economic risk, as these investments may be relatively large and especially if they cannot be carried by the income from the area.

On the revenue side the economic risks include the possibility of lower than expected fee income from municipal services provision and lower than expected tax income from the different forms of taxation. The municipal property tax income is the least risky source of income, as it is on buildings and land that cannot be transported away from the municipality. Income from the municipal tax on personal income and the part of corporate income tax allocated to municipalities may vary, depending on area demographics changing. Service fees may also face variability that is caused by demographics, variability that may be out of sync with the costs of providing the same services (fixed costs remain constant). The post-construction phase economic risks can materialize as extremely negative from the point of view of the municipalities, because in cases of negative demographical changes many, even all, of the post-construction phase economic risks may be realized simultaneously. Examples of such demographic changes exist, e.g., in areas constructed relatively long ago, where the inhabitant basis has changed from upper middle class, rather senior people with no children, to lower middle class families with families. In such cases, the need for kindergarten and school services has grown from the demographic change causing extra investment needs into buildings and services, with simultaneous tax income drop from the

same area. Such "demographic shocks" may cause a cash-flow positive area to become cash-flow negative. If the planning has been made to reflect a zero economic result and no buffers have been collected the overall result may end up being negative from the point of view of the municipality. This will lead to pressures of implementing, e.g., higher fees and taxes. Other demographic shocks may be caused, e.g., by ageing population where a need of new seniors' services are accompanied with lower municipal tax income.

Table 1 summarizes some of the financial risks that face municipalities in their traditional way of involvement in area development projects.

In short, the blueprint of the traditional involvement policy of the Finnish municipalities from the area development projects has been (is) the following :

i) Invest and buy un-zoned land
ii) Do the planning and the zoning of the un-zoned land / require contractual payments based on the land use agreements
iii) Sell the zoned land (partly or fully) to cover the planning and zoning costs and the expected costs of municipal engineering, and partly the cost of service facilities construction (pricing of the zoned land, or the zoning charges to match these costs, often no profit requirement, or very low required return)
iv) Act as the inspecting authority in the construction phase and construct the municipal engineering (municipality being the cost carrying party)
v) Receive personal municipal tax, municipalities' part of the tax on corporate income and municipal land tax cash-flows from the individuals, companies, and buildings located in the developed area, use the tax income to finance partly the services provision and maintenance of municipal engineering. Receive lease payments for the land not sold.
vi) Provide services and receive some cash flows as payment for the services (prices usually set to be lower than the cost of provision)
vii) Maintain the municipal engineering, receive some cash-flows for the maintenance

The municipalities' traditional policy objective is that the whole "chain of involvement" (i–vii) should result in the development of the area according to the plans, with a close to a neutral overall, long-run financial result (no gain, no loss) from the projects to the municipality.

The economic risks associated with the presently used traditional policies of municipalities' involvement in area development projects are found in all stages of these projects, however, the *most important economic risks* within the present involvement policy seem to be concentrated in the construction phase and in the post-construction phases. In the construction phase the economic risks can materialize in the form of possible cost overruns of municipal engineering & infrastructure construction and in the form of unexpected and costly investment needs and lower

than expected income from taxes and services. The economic risks in the post-construction phase can be caused, e.g., by a demographic changes in the area. The economic risks in the traditional involvement policy model are mainly caused by the fact that municipalities are not in control of the revenue and cost cash flows, i.e., they do not have the possibility to proactively steer the issues that cause the economic risks or that could control these risks; if alternative involvement policies exist that give the municipalities a possibility to take (even limited) action when economic risks are about to materialize, then the level of the economic risk in area development projects could be made lower.

Before we go ahead with mapping of the different policy options Finnish municipalities have (to change their traditional involvement policies), we will do a short review on selected articles that discuss real option analysis in land valuation and infrastructure investments.

1.3. Review of Selected Articles on Real Options in Land Valuation and Infrastructure Investments

The idea of real options is an old one, but the term "real options" was introduced in (Myers, 1977). Since the coining of the term, using option valuation models to frame analogous real investment problems has been growing, and real options are a subject of increasing attention among both academics and practitioners. Real options literature can be divided roughly into two categories, general theory and application. Some topics on the general theory side have been, e.g., entry and exit decisions, growth options, and the valuation of interrelated projects. Real option valuation has been applied notably to some specific types of industries and situations, e.g., to petroleum, mining, natural resources in general, information technology, and corporate strategy. Real options have also been found to be useful, when framing real estate and area development related problems. Focus of the research on real options with a direct connection to area development has mainly been in estimation of option value in land prices, the real options premium, and in use of real option valuation in the optimal timing of development projects. Staging of investments is also an issue that is relevant to area development and it also has been researched in connection to real estate. As zoning and other regulatory issues play a role in the value of the options embedded in the value of vacant land the effects of regulation in option value have also been studied. In the following a selection of six research papers are presented to illustrate the previous research on real options on topics close to area development and discussed to underline *some relevant points* to the Finnish area development projects.

In the first reviewed paper Titman presents a two-period binomial model where he views vacant land as an option (to develop) (Titman, 1985). The development will increase the value of the land (and will enable a payoff), however, the development also means costs. The development costs are modeled to be at least partially irreversible. The paper finds that, as there are irreversible

costs and there is uncertainty, the option to wait that the landowner has is valuable. This situation can be modeled as an option, where owning the undeveloped land gives the option. The developed land is the underlying asset, and the development cost is the exercise price of the option. In the paper Titman does not include a maturity for the option, which however, in real life may be finite. The paper concludes that as the possibility to wait is valuable, this value should be reflected in the (sales) price of undeveloped land. The model presented in the paper returns results that indicate that the market price of undeveloped land is higher than the price of a developed property, development costs deducted. The paper presents a numerical example for illustration. The starting situation presented in the paper, from the point of view of Finnish municipalities means that the land is already zoned, i.e., the zoning gives the land-owner the right to develop (construct) on the land. This means that as Finnish municipalities often are owners of un-zoned land, they actually have an option to zone that gives the option to construct. As the Finnish municipalities have the lawful right to redeem un-zoned land the maturity of the real option to develop is finite for Finnish land owners, however, it may be considered infinite for the Finnish municipalities as land owners.

In the second paper, Williams presents a model that illustrates the optimal time to develop land and the optimal time to abandon land (abandoning meaning here selling, or terminating a lease / rental agreement) (Williams, 1991). The model takes into consideration the change in development costs and the advantages from development; these affect the optimal time of starting development. The model also considers the building density and the amount of total land that is developed. What is also considered is the possibility of changes in the risk level, by taking into consideration the possible changes in the speed of price changes. The findings of the paper include the observation that a lower zoning density has the tendency to slow down starting of development and that high density seems to generally add to land value, except for some special circumstances. Finnish municipalities should pay attention to making the zoning such that it increases the chances of obtaining the expected price for the zoned land and by considering the optimal timing of land sales for maximizing of profits. Optimal timing is also discussed in, e.g., (Benaroch & Kauffman, 1999).

The third paper, by Quigg investigates 2700 land sales and 3200 developed site sales in the Seattle area (USA) in the later period of the 1970's, with a model that assumes stochastic (geometric Brownian motion) changes for the development cost and the value of developed land (Quigg, 1993). The model resembles the model from (Williams, 1991) with some extensions. The paper discusses the estimation of the development (how the type and size of the construction is to be estimated), and uses hedonic pricing. This method estimates the price of the developed property with a formula that takes into consideration a number of characteristics of the developed property, e.g., land area, building age, distance from public transportation etc. The hedonic

method structure resembles, and has some analogy with the structure of the arbitrage pricing theory. The paper discusses the variance of property prices and discusses some previous results; variation of prices for the data between 18–28% and comparison to previous results of ~15% variation. The finding of the paper is that most properties would not be developed at the observed levels of variation, if the developers calculated the value of the real options correctly, i.e., the option value of the land would be so high that it would prevent development due to the high volatility. However, if the volatility was assumed to be zero, then development would start immediately, naturally indicating NPV positive construction. In the data Quigg studied, the value of the option premium has a mean of 6% of the land value.

The fourth reviewed paper by Yamaguchi examines the real option premium in Japanese land prices by using a model adopted from (Quigg, 1993), i.e., they also use the hedonic estimation method to estimate the price of developed land (that would be developed on the vacant land); adopted for Tokyo (Yamaguchi, 2000). The dataset is of 754 mostly residential observations from Tokyo from the mid 1980's and early 1990's – the periods are very dissimilar as in the mid 80's Tokyo land prices were in a boom and in the early 90's there was a period of stagnancy. The authors express an interesting point (in presentation slides) that the option premium value can be understood as the inverse of the landowners willingness to develop the land, i.e., the more option value there is the less willing are the landowners to develop the land. The volatility that the authors find for the different periods, boom and stagnancy are interesting, at the boom time the volatility is markedly higher ~37%, but in stagnant market the volatility is about half, ~19%. The interesting finding is that the results show that real option premium is over 18% for both periods of observation, i.e., same level of premium even if the volatility is different. This implies that landowners seem to value the optionality in a similar fashion in different times, indicating rational behavior.

From the two papers using the hedonic estimation for pricing of land, one could pick out an interesting issue that has a real options focus for the Finnish municipalities. It would be interesting to see by using a hedonic scoring how land destined for an area development should be zoned. The municipalities have a zoning monopoly and have the power to decide about the zoning, i.e., hold the zoning real options; the zoning could be optimized in a way that it would maximize the land value. Naturally some constraints would have to be taken into consideration in the process, however, this kind of optimization and exercise of the real option to change zoning could prove to be a valuable tool for municipalities. The papers also indicate municipalities could force the land buyers to develop faster by contracting the land sales in a way that they take out the buyers' option to wait. This is something that is also done in Finland. Issues having to do with real options in zoning are also discussed in (Capozza & Li, 1994a; Capozza & Sick, 1994b).

A fresh example of a paper exploring the option value of land is by Ooi that investigates the

real option value embedded in the price of plots of land via comparing land auction prices with and without restrictions to the development of the land (Ooi, 2006). They exhibit and draw conclusions from a sample of 165 public land auctions and 105 private sales of land in Singapore; where the publicly auctioned plots are basically stripped of real options (only specified type of construction allowed and no timing possibility), and where the privately sold land includes the real option value. The findings of the paper are that as the plots are very similar in both, the public and the private auctions, ceteris paribus, about 45% of the value of the private sales (higher sales price) can be attributed to the value of real options. The paper has also investigated the explanatory power of the research (the issue of real options really attributing for the value/price of the plots), and found that the option value explains the price / value increase for over 90% – this indicates that the finding is reliable. The premium caused by real options seems to be high, when we compare with other results, however, this can most likely be attributed to the specific location (Singapore) and the time of the study. In Finland there are instances where municipalities sell zoned land in auctions, however, this applies to cases where the auctioned land is sold in small plots, and usually in areas where the zoning is for individual residential buildings, i.e., villas. In the Finnish area development auctioning is not the usual way to sell land, even if there may be bidding competitions between constructors, but in these cases the bid is not for the land alone, but usually for the realization of a whole project, and the selection is made based on a number of issues, like quality and soundness of the plans, not only the price.

The paper by Rocha approaches the options in land use from the perspective of having the option to stage development of larger areas (sequential development), in contrast to developing all-at-once (Rocha, 2007). Their paper can actually be understood as describing an area development situation. They illustrate with a case from Brazil, and the paper discusses the situation within the context of emerging markets that carry high risk. The point of the paper is to show that under high uncertainty, especially high in developing countries, it may be beneficial to use the option to wait after a first stage development, due to sudden violent swings in the market.

The discussion is directly applicable to any properties market as the sub-prime crisis in the USA has shown (not only developing countries' properties markets experience sudden large swings). The paper presents a case from the Rio de Janeiro that illustrates a situation where it is beneficial to postpone the second investment phase. The effect on the risk of the project is shown (the downside is more limited). In the paper, changes in the variance of prices that have been observed in some previous publications, e.g., (Quigg, 1993; Yamaguchi, 2000) have been ignored. The paper offers useful insights for the Finnish area development projects, especially regarding the construction phase of the area development projects.

The reviewed papers are closely connected to this research as they represent parts of the system of real options that this paper presents in the following section. The notion of having se-

quential options in the process of area development is supported by these earlier findings. The observation that there is positive value to the possibility of being able to choose the followed policy according to how things play out is clearly voiced in (Rocha, 2007) and corroborates the fact that a historical, common-for-all policy may not be the optimal policy alternative in area development projects.

All of the above discussed papers have in common that they use Black-Scholes model, or the binomial model for the valuation of real options. These two models expect that the underlying process that describes future events is known and can be explicitly quantified. For area development projects with long and very long construction times such assumptions may be too optimistic, especially as the information that is used in the analysis is mostly in the form of different experts' opinions, from which the cash-flow scenarios used in the numerical analysis of these projects are usually built. For a numerical analysis of area development projects we suggest the use of the Datar-Mathews method or the fuzzy pay-off method.

In the following section of this paper we will look at the strategic (policy) level real options Finnish municipalities have at their disposal regarding area development projects and discuss the possibilities they offer. We will also map the real options within the different area development project phases and discuss if, and how, Finnish municipalities could use them to optimize the profitability of their involvement in area development projects and for purposes of managing the economic risk level of area development projects. We will also discuss how the selection of the best (most profitable) area development strategy can be done by combining strategic level real options.

2. MAPPING AVAILABLE REAL OPTIONS AND MANAGING THE PROFITABILITY & THE ECONOMIC RISK LEVEL IN AREA DEVELOPMENT PROJECTS FOR MUNICIPALITIES

2.1. Mapping Available Real Options

In area development projects municipalities have both, strategic level (policy) options and operational level (project) options available to them. The strategic level options include:

i) Timing options – the option the municipalities have to time the start of the project. Project start timing is an issue that is controlled by the municipalities, because they have zoning monopoly and thus decide when the project is zoned. Giving construction permits decides the timing of the construction phase, this is also controlled by the municipality. Municipalities cannot normally choose the beginning of the post-construction phase, but start of the construction phase is obviously connected to this timing as well.

ii) Option to continue involvement / option to decide the level of involvement. The municipalities decide themselves how high their level of involvement in area development projects is. They decide if they want to continue as land owners into the construction phase or not, and if they want to continue into the post-construction phase as owners of buildings, acting as land lords.

iii) The option to abandon the assets in the project. The municipality can abandon its ownership of the assets it owns partly of fully. The abandonment means here the full or partial sale of the project assets owned by the municipality, e.g., land or buildings. The municipality cannot fully abandon area development projects, because of the legal obligations the municipality has (service provision, upkeep of infrastructure etc.). The municipalities can, in essence abandon revenue creating parts of the projects, but cost creating parts cannot be easily (if at all) abandoned; outsourcing of, e.g., infrastructure maintenance can however be done.

The operational level real options include the operational choices and possibilities within the different project phases, e.g., the possibility to stage investments within separate stages (staged zoning, staged construction, etc.). Operational real options are numerous, ranging from "big issues" to "small issues" – timing of building of whole buildings to timing of installing carpets. In the ex-ante area development analysis "small issue" related options are usually forgotten to keep the analysis at a tractable level of complexity. In this paper we mostly concentrate on the strategic level real options, but some examples of operational real options are given. Figure 2. maps the identified strategic and operational real options available to municipalities. They are listed and discussed in the list below according to the indications in Figure 2:

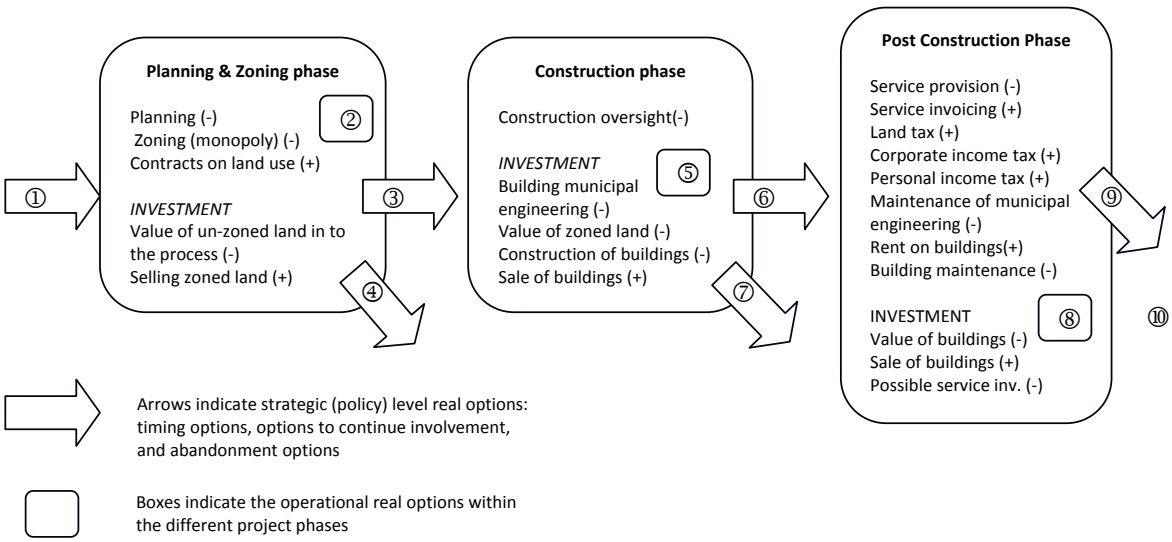

Figure 2. Selected strategic and operational level real options available in Finnish municipalities' involvement in area development projects, with cash in- (+) and out-flow (–) information for each of the three project phases.

① *Strategic level timing options* to time the starting of the project. By controlling the start of the zoning of land, the municipality can decide when the project starts. When the municipality is a land owner it is possible to exercise the option to postpone the zoning to optimize the revenue / market value of the zoned land that is dependent on the overall economic situation. It is worth to note that in a positive market it may be easier to reach consensus on contracts on the use of land discussed above in section 1.2. These options are sometimes utilized by Finnish municipalities. There is are a number of real option papers that discuss the real option to defer in more detail, see e.g. (Lander & Pinches, 1998) for a list of references.

② *Operational level options in the planning & zoning phase.* Municipalities have the possibility to stage the zoning of the land to optimize the value of the zoned land. This can mean, e.g., that during slow times the zoning is stopped and when the economic situation becomes better and the demand for zoned land increases, and causes the market value to grow the zoning is restarted. Zoning related options are private to the municipalities, but it may be politically difficult to halt zoning of private land without the consent of private landowners. In fact, as area development projects are large long-term projects the decisions are usually made up front in consensus with private land-owners and constructors – in such cases staging the zoning is not a possibility, unless it has been commonly agreed upon. Staged investment is a topic that has been widely discussed in the real options literature, see e.g. (Lander et al., 1998) for a list of references. Applications of the hedonic model presented in (Quigg, 1993; Yamaguchi, 2000) may be applicable, when area development zoning is optimized.

③ *Strategic level option to participate in the construction phase*. By continuing their involvement in the area development project to the construction phase, the municipalities are exercising an option that is similar to what is commonly referred to as an option to grow. This is exercisable by the municipality by investing the zoned land into the development project (and not selling the zoned land on the markets). *Strategic*

level option to postpone the investment into the construction phase is also available to the municipality. There is also a restricted possibility to postpone the construction of the municipal engineering & infrastructure; the restrictions are caused by the legal obligations invoked by the zoning. The possibility to continue involvement into the construction phase is very seldom utilized by the Finnish municipalities, with the exception of some larger cities. A notable exception is also the situation when municipalities decide to build municipal (rental) housing units that are to be rented at preferential city rates (social policy); in these projects municipalities usually act alone, not together with private land owners. Similar situation is presented, e.g., in (Titman, 1985). Growth options have been discussed in many real option papers see, e.g., (Lander et al., 1998) for a list of references.

④ *Strategic level real option to sell the zoned land*, fully or partially. This is the most often utilized "policy" of the Finnish municipalities, and it is usually exercised in the form of selling the zoned land to private contractors, investors, or home builders. This option is sometimes utilized in the form of leasing the zoned land (and effectively leasing the real option to construct). Similar options in the same context are presented, e.g., in (Williams, 1991). The municipality naturally also has a possibility to postpone these actions.

⑤ *Operational level real options within the construction phase.* These include, e.g., staging the building of municipal engineering & infrastructure and the construction of the buildings. Staging construction projects is a way to limit the risk in area development projects, see, e.g., (Rocha, 2007). In addition to the possibilities to stage construction there are a number of different "low level" operational real options related to how infrastructure and buildings are built, i.e., modularity for flexibility of use etc.

⑥ *Strategic level option to receive rental income*. By continuing involvement to the post-construction phase the municipality will have a possibility to receive rental income from the constructed buildings. This option is exercisable by the municipality by investing the developed land (with buildings) into the post-construction stage. The option is available only by having already entered the construction phase. This possibility is seldom utilized by the Finnish municipalities, except for when done for social policy reasons, i.e., not utilized in large scale to promote cash in-flow from renting as a municipal business. This possibility again resembles a growth option.

⑦ *Strategic level real option to sell the buildings and the underlying land*. The municipality can sell the buildings and the land directly after the construction phase. This is possible fully or partially. The municipality can also postpone the sale of these assets, if the sales price is expected to rise in the near future.

⑧ *Operational level options within the post construction phase*. These operational options include, e.g., changing the zoning for buildings to allow a different use and changing the size of units (conditional to having built these possibilities into the facilities in the construction phase. These possibilities resemble the real options to switch inputs or outputs and the options to alter operating scale, see e.g. (Lander et al., 1998) for a list of references.

⑨ Strategic level real option *to sell the buildings and the underlying land*. This is a possibility that the municipality has when it has retained ownership of land and building assets to the post-construction phase. Having such assets available for sale the municipality can, e.g., counterbalance costs of investment needs arising during the lifetime of the area development project.

⑩ *Strategic level real option to re-zone the land* used in the area development. This possibility is similar to what is presented, e.g., in (Capozza et al., 1994b). Re-zoning is sometimes done by Finnish municipalities, but almost always on the basis of requests from private land owners on their land (contracts on land use apply), see, e.g., (Eerolainen, 2005), or on land owned by the municipality. The option to re-zone is a very

interesting option as it makes the zoning process reversible. The re-zoning option is available all of the time during the economic life of the area development project, however it is realistic to expect that it can be exercised before entering the construction phase (when no buildings are built yet), or after the whole profitable economic life of the already developed project. The option can be exercised partially, i.e., partial re-zoning is also possible.

The above mapping of strategic (policy) level real options and operational level real options available for Finnish municipalities in area development projects can be used to describe and develop new policies of involvement in area development projects that may result in reaching a lower level of economic risk, than is present with the traditional involvement of Finnish municipalities in these projects. Combining the above mentioned strategic level real options to form alternative (profitable) area development project involvement strategies allows municipalities to have more degrees of freedom than *always* rigidly choosing the traditional policy.

2.2. Using the Available Strategic Level Real Options for Maximizing Profitability and Managing Cash Flows to Reach Lower Economic Risk Levels

In the section 2.1. we have mapped and described the identified strategic level real options available to Finnish municipalities in their involvement in area development projects. What we have found is that there are multiple strategic and operational level options available at each of the three stages of the area development projects. We have described in the section 1.2. the traditional role of Finnish municipalities in area development projects and seen that the most important economic risks within the traditional role come from the possibility of cost overruns in the municipal engineering & infrastructure construction and from the inability of municipalities to proactively (in other forms than tax or fee increases) affect the income from a developed area. This is due to the fact that the municipalities traditionally are no longer owners of the property, land, or buildings (other than service facilities, which are rather more a liability than an asset) in the construction and post-construction phases.

When comparing the traditional involvement of the municipalities and all the strategic level real options available, we can see that municipalities do not seem to be analyzing the possible advantages (and the value) of available possibilities to extend their involvement in area development projects further. By continuing their involvement further the municipalities may be able to decrease their economic risk level, because they can in that way retain the possibility to proactively change the timing and the size of cash flows from the area development projects. This means that if municipalities have sellable assets in the later stages of area development projects, and an unexpected investment need arises, these assets can be sold to offset the investment costs. Flexibility that is gained through extended involvement is valuable and can be used proactively, which

can result in a reduced economic risk level.

An important point to notice here is that if the municipalities (according to the traditional policy) sell all of their assets in the planning & zoning-phase, the price received for the sale may not be optimal for the municipality. This is, because the value of the strategic real options for the municipality cannot necessarily be included in the sales price of the zoned land; the buyer is not ready to pay for value that would come to the municipality, but cannot be realized by the buyer. Estimation inaccuracy with regards to the cost of building municipal infrastructure can cause the revenue from land sales to be too small to be able to cover the costs – even if the sales price is, at the time of the sale, considered to be enough the actual building costs can turn out to be higher. The closer the sale is to the actual building, the less estimation error there is likely to be. If the sales price of the assets, when using the traditional involvement policy, includes the full value of the strategic real options available for the municipality, then the municipality can be indifferent about whether to sell or not, however, if this is not the case, then the municipality should not sell, but continue into further phases of the project to realize maximal value.

The relevant question to ask is, if the traditional policy use is the result of careful in casu analysis, or a situation that is caused by ”doing things the way they have always been done”? It is our understanding that the situation is a result of the past, and not the result of an economic analysis of the optimal area development project involvement policy. If this is the case, will remain open, however, let us investigate how the available strategic level real options could be used in proactively managing cash flows and reaching a reduced economic risk level in the municipalities' involvement in area development projects.

Table 2 presents the economic risks that we have observed in the different phases of the area development projects, including some ”new” economic risks that originate from municipalities' possible enlarged involvement in all the three stages. In the Table 2 examples of different available identified strategic and operational real options are mapped against the economic risks in the different phases, and possible revenue optimization and cash flow management uses of these real options are suggested.

New involvement policies, suitable for each individual area development project and market situation, can be designed with the help of the mapping of the available real options. Issues like creating a fixed income sources for the municipalities by exercising, e.g., the option to receive rental income, by entering the post construction phase as a land and building owner will be likely to decrease the risk from the fixed costs that municipalities have from developed areas, as there is counterbalancing fixed income. In the literature review we saw that staging development can be used as a method to reduce risks (Rocha, 2007), staging municipalities actions in area development projects is also likely to reduce risks. This applies for many activities, e.g., zoning, construction of infrastructure & buildings, and sales of land & buildings.

TABLE 2. Economic risks facing Finnish municipalities in each of the three stages of the area development projects and possible uses of selected available identified real options to reach a lower risk level. New economic risks caused by a possible higher level of involvement in italics.

	Revenue Cash Flow Management	Costs Cash Flow Management
Planning & Zoning Phase risks • Sales price of zoned land lower than expected (2) • Contracted land use payments lower than expected (1) • Planning cost higher than expected (1) • Zoning cost higher than expected (1)	① ② ③ ④ • Using the option to postpone the start of the project to optimize cash flow • using the option to postpone the land sale to optimize revenue • staging the zoning and land sales to optimize timing & value/ revenue • using the land to enter the construction phase to enable higher revenues in the future or for extra income (reduces risk of overall negative)	① • Using the option to postpone the start of the project if the costs are at a too high level (cost / benefit ratio not good)
Construction Phase risks • Municipal engineering cost higher than expected (5) • *Construction cost higher than expected (5)* • *Income from sale of buildings lower than expected (4)*	⑥ ⑦ • Using the option to postpone the sale of buildings to maximizing the sales income • In case the market price of buildings does not warrant sale the option to receive rental payments can be exercised as the first step in the process of waiting for "better times"; the return on the rental income may even be, per se, acceptable	⑤ • Staging construction to find out if the contracted constructor causes cost overruns; keeping the option to change the construction company
Post Construction Phase risks • Personal municipal tax income lower than expected (4) • Municipalities' part of the tax on cor-porate income lower than expected (3) • Service revenues lower than expected (2) • Service provision (need) costs higher than expected (4) • Maintenance costs higher than expected (3) • *Rental income lower than expected (1)*	⑥ ③ ⑧ ⑨ ⑩ • If ownership of buildings kept then receiving a continuous stream of rental income will complement cash-inflow from the area; this will counterbalance continuous costs from the area • Operational options within buildings make it easier to maximize rental income • Sale of the buildings can be used to offset investments that are made in the area • If the area as a whole turns out to become a highly negative cash flow problem for the municipality the option to re-zone and re-develop the area is possible	⑧ • Operational level options to change the functionality of constructed buildings may enable the change of purpose of use, which may make change of purpose an alternative to new, larger, green-field building construction investments

Entering the construction phase as a contractor (or with a profit sharing agreement with a contractor) may be used to generate another new source of income for the municipalities that may generate substantial income. At the present in Finland this income is reaped by private construction firms and this has aroused some interest in the market situation of rapidly rising property and condominium prices; why have the municipalities played themselves out from this obvious source of income? The answer may be in the ”that is how it always has been done” dating from the first area development projects in the mid 1960's; it was then in the best interest of the municipalities to allow constructors build fast and reap profits to ease the large cities´ housing shortage.

The selection of the best combination of strategic level (and operational) real options is not simple and may become impossible if there are no numerical analysis tools available for use. We suggest that one possible way to make the selection is to consider the profitability of the different policies (profitability of the different combinations of real options) as a criterion. In the following section we will shortly discuss how such profitability based strategy selection analysis can be performed.

2.3. On Selection of an Area Development Strategy

A very simple approach to analyze the goodness of different municipal area development project involvement policies is to compare the economic profitability of these policies. For the purposes of this presentation we define the different policies as different combinations of available strategic level real options (we omit the operational level options for simplicity). In this kind of a setting the combination: start project zoning immediately – enter into construction phase – sell (abandon) buildings and land after construction, is one possible policy alternative; using the numbers presented in figure 2 this can be shortened to 1-3-7. This combination, i.e., the profitability of this combination, can then be compared with the profitability of other combinations, like the traditional policy combination: zone land – sell zoned land, or 1–4.

The evaluation of the profitability of these compound real options is not without challenges, as their valuation is the valuation of compound real options. There are support systems that have been built to assist in the profitability analysis of area development projects that allow also analysis of different alternative policies (Lagus, 2008). For solving the compound real option value of the different policies the pay-off method for real option valuation can be applied (Collan et al., 2009a). Optimization with regards to the profitability for the municipality can be done, if all the relevant applicable strategic real option combinations are valued and the combination with the best profitability for the municipality is selected as the involvement policy to be used in the area development project.

3. SUMMARY AND CONCLUSIONS

We have presented Finnish area development projects as multi-million euro, long term construction projects that can be divided in to three phases according to the activities conducted, and presented each one of the phases: planning & zoning, construction, and post-construction. We have discussed the Finnish situation from the point of view of the involvement of the Finnish municipalities. We illustrated the present situation, i.e., the traditional policy of involvement of Finnish municipalities in area development projects and discussed it from the point of view of the identifying the economic risks and rewards from the policy. We further discussed the economic risks and their causes in each of the project phases. Then a short preview of selected articles on real options in land valuation and infrastructure investments was presented, followed by a mapping and identification of the, for municipalities available, strategic and operational real options in area development projects.

We compared the available identified real options with the economic risks in the projects and discussed ways in which the real options can be used in maximizing and managing the project cash flows and reaching a lower economic risk level for the municipalities' involvement. We suggested some examples for new policies for Finnish municipalities' involvement in area development projects and shortly discussed how the selection of a "best" policy for a given area development project could be made. We conclude that by using the available strategic and operational real options Finnish municipalities can increase their knowledge about the profitability of area development projects, and by doing so are likely to be able to decrease their risk level, when entering in area development projects. ■

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