

# **Disturbed Circulation of Land Use - Supporting Brownfield Sites for Sustainable Development of Land (0583)**

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**Key words:** Revitalization of Brownfields, Sustainable Development, Circulation of Land Use, Land Management

## **SUMMARY**

Since industrial revolution, the need of area of settlement and infrastructure grows contrary to shrinking of population. Provision of building land takes place mostly on Greenfield sites, so areas of Greenfields get fewer. Hence, Germany set target to reduce land consumption and pretend relationship between land consumption of inner-city to Greenfield as 3-to-1. In addition, development is focused on Brownfield sites.

A healthy circulation of land means the change of land use. Greenfield sites get in use and after a span of time use is not needed any more. In consequence, the use has to be changed.

Today the circulation is often disturbed especially for old industrial or military sites. The change of use does not happen without support, so Brownfield sites arise. Brownfield sites are areas of derelict land which use is lost often because of structural change. Development is hindered by a lot of reasons. Biggest problems are normally contaminations. So circulation needs external help to initiate a new use even if it is only to release the area as Greenfield sites - but without or secured contaminations.

On one side Brownfield sites provide possibility to solve problems of areas with overlapping land uses. They are characterized by their good position in city where often planning law exists. On the other side they are hindered by contamination also as open liability and ownership in many cases. Furthermore declination between land value of rural and urban area encourages investments in Greenfield. Therefore, development of Brownfield sites does not present itself as attractive for investors as it should be in view of land consumption and capacity of Brownfield sites.

Studies show that development of Brownfield sites depends on five groups of influencing factors. Besides conception and preparation of a site, participants, financial and legal frame affect development.

One chance of stabilizing the circulation of land is the transformation of plants into industrial-parks especially for sites where habitation use is impossible. Often old plants do not need so much area for their site. So new sites have to be found or old sites opened for external investors. Old plant structure could be used to invite new companies to settle down and participate in good infrastructure with sharing the costs incurred.

Future aim is a discrete better knowledge of influencing factors to make revitalization more attractive for developers and encourage the transformation in industrial parks wherever applicable.

## SUMMARY (Zusammenfassung)

Seit der industriellen Revolution steigt der Flächenbedarf für Siedlungs- und Verkehrsflächen - trotz mittlerweile sinkender Bevölkerungszahlen - stetig an. Die Baulandbereitstellung erfolgt vorwiegend auf der „Grünen Wiese“ und verursacht eine Abnahme des Freiflächenanteils. Deutschland hat sich daher zum Ziel gesetzt, die Flächeninanspruchnahme zu reduzieren. Angestrebt wird ein Verhältnis der Innen- zur Außenentwicklung von 3:1, wobei insbesondere Brachflächenstandorte für die Bauflächenentwicklung in Anspruch genommen werden sollen.

Ein gesunder Flächenkreislauf beinhaltet die eigenständige Änderung der Flächennutzung. Zu Beginn werden die Freiflächen in eine (bauliche oder sonstige) Nutzung überführt. Im Laufe der Zeit wird diese Nutzung nicht mehr benötigt und es bedarf der Nutzungsänderung.

Heute ist dieser Kreislauf insb. für ehemalige Industrie- und Militärstandorte vielfach gestört. Die eigenständige Nutzungsänderung kann ohne externe Unterstützung nicht mehr erfolgen und es entstehen Brachflächen.

Als Brachflächen werden verlassene Flächen bezeichnet, deren Nutzen meist aufgrund des Strukturwandels verloren gegangen und deren Entwicklung bedingt durch die verschiedensten Gründe gestört ist. Im Regelfall stellen Kontaminationen die größten Schwierigkeiten für die Entwicklung dieser Standorte dar. Daher bedarf der Flächenkreislauf externer Hilfe, um eine neue Nutzung zu initiieren, selbst wenn diese nur als sanierte oder gesicherte Freifläche weiterbestehen kann.

Brachflächen bieten einerseits die Möglichkeit, stadtstrukturelle Probleme zu lösen. Sie zeichnen sich durch ihre gute Lage in der Stadt und z. T. vorhandenes Planungsrecht aus. Andererseits ist die Entwicklung der Flächen oft durch Kontaminationen, offene Haftungs- und ungeklärte Eigentumsfragen gestört. Darüber hinaus ermutigt die Bodenwertdifferenz zwischen ländlichen und städtischen Gebieten Investitionen auf der „Grünen Wiese“. Somit stellt sich die Brachflächenrevitalisierung für Investoren als nicht so attraktiv dar, wie sie es in Hinblick auf die Flächeninanspruchnahme und die Brachflächenkapazitäten sollte.

Studien zeigen, dass die erfolgreiche Entwicklung der Brachflächenstandorte von fünf Gruppen von Einflussfaktoren abhängt: neben Konzeption und Vorbereitung des Standortes wirken die beteiligten Akteure sowie der finanzielle und rechtliche Rahmen auf die Revitalisierung ein.

Eine Möglichkeit zur Stabilisierung des Flächenkreislaufs ist die Transformation von alten Werksstandorten in Industrieparks. Dies ist insbesondere dann möglich, wenn sich die Flächen nicht mehr für eine Wohnbebauung anbieten. Alte Werksstandorte bedürfen häufig nicht mehr der historisch bedingten großen Flächen. Entweder suchen die Unternehmen neue kleinere Flächen oder öffnen den Standort für externe Investoren. Die alten Werksstrukturen erweisen sich für neue Unternehmen als interessant. Durch die Ansiedlung im Industriepark können sie unter Kostenbeteiligung von der guten Infrastruktur partizipieren.

Ziel weiterer Studien ist das bessere Verständnis der einzelnen Einflussfaktoren, um die Attraktivität von Revitalisierungen für Investoren zu erhöhen und falls möglich Eigentümer alter Werkstandorte zu Transformationen in Industrieparks zu ermutigen.

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## **1. INTRODUCTION**

Since industrial revolution, the need of area of settlement and infrastructure grows.

In the past, surveyors were engaged in allocation of building land. Instruments - like land reallocation in Germany - were created for implementation of building land, which had been offered through land use plans before. These instruments are mostly focused on open space and allow a rapid transformation of undeveloped land into building land. Due to these activities, the proportion of building land is especially in industrial nations very high. An above-average claim for area of settlement and infrastructure affects particularly countries with a high population density, though available open space declines. Nevertheless, allocation of building land occurs by developing open space - so called Greenfield sites. This trend proceeds in spite of shrinking population increase.

Importance of Brownfields revitalization and a healthy circulation of land use will become more important because of the great need for building land in combination with absence of Greenfield sites.

Limitation of building land development on abandoned industrial sites means protection of worthy open space. Furthermore, it conservates and accordingly fortifies urban structures due to integration of new sites in urban development. By revitalization of Brownfields, economic growth will be uncorrelated from designation of building land on open space.

Comparing developments of Greenfield Sites with revitalizations of Brownfields, it is important not to make only a management analysis. Many advantages of revitalization can only be quantified (Doetsch and Rüpke 1997).

Without constraints or commitments, private investors will only revitalize Brownfield sites if it is profitable.

As a result, field of activity for surveyors working in land management changes from long standing building land production to a sustainable land use change within circulation of land use.

## **2. CHANGES OF SETTLEMENT AND LAND CONSUMPTION**

Land use in Germany could be divided in area of settlement and infrastructure, agriculture land, forest, water area and other uses like mining land. Agriculture land dominates. Most urban developments cause new born area of settlement and infrastructure. This land use category includes area of building and open space, area of infrastructure as well as area of recreation and business. Area of settlement and infrastructure is not a synonym for sealed area. Only 50 % of this area is sealed.

Soil is the central resource for sustainable settlement development. Increase of area of settlement and infrastructure results from account of agriculture land (Fuhrich and Stuckstedde 2002).

Land consumption of area of settlement and infrastructure raised in Germany. In the years 1999 - 2001, it peaked out to 131 ha per day. Last census shows a decline of 93 ha per day or 11 sqm per second. This decrease means no reversal trend but a result of building investment collapse.

This tendency is caused by multiple factors. An inhabitant requested 15 sqm living area in 1950 and 40 sqm in 2001. In addition, settlement development is focused on single-family houses in countryside. As a result, need for infrastructure area is because of sprawl much greater than in urban area with a minimum of density. Furthermore, business, recreation and other uses require more space for their needs (Bundesamt für Bauwesen und Raumordnung 2006).

The traditional European city fades away and accordingly the concept of a dense, compact urban city with its clear border to the rural area (Apel et al. 2001). Urban and rural areas grow together, but because of declination of population, existing infrastructure is not used to full capacity. Besides old industrial sites get out of use, and Brownfields grow up. Result is a perforated city.

German government sets up a national strategy of sustainability in 2002. It set target to reduce land consumption to 30 ha per day until 2020 and to pretend relationship between land consumption of inner-city to Greenfield as 3-to-1. Furthermore, the development is focused on Brownfield sites (Bundesregierung 2002), which the “Bundesamt für Bauwesen und Raumordnung” estimated at 139,000 ha in 2004.

### **3. DEFINITION OF BROWNFIELDS**

Brownfield sites are areas of derelict land which use is often lost because of structural change. The term “Brownfield” has country-specific different definitions. Legislator gives no formal definition, but Germany follows the definition of the Environmental Agency of England and characterizes Brownfields as derelict land:

*“Land that is so damaged by industrial or other development such that it is incapable of beneficial use without treatment”* (Environmental Agency 2002).

In the international understanding of “Brownfields”, the term refers to contamination of land. For example, the German definition differs from the U.S. American definition. Their legislator says:

*“The term ‘brownfield site’ means real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant”* (Small Business Liability Relief and Brownfields Revitalization Act 2002, Title II, Sec. 211a).

According to the American definition, contaminations prevent development, whereas the German and the British definition make no statement about the hindering damage. But not

each Brownfield is contaminated, even if there had probably been a former industrial use. Otherwise not each contaminated area has to be derelict land. Many of them could be still used profitable.

Therefore in Germany, “Brownfield” does not mean stringently a contaminated site, but characterizes usually not used area, which former use got totally or in parts abandoned and no new use could be found.

#### 4. CIRCULATION OF LAND USE

Circulation of land use shows changes of usage in pass of time. Land runs through different stages. In the beginning of circulation, open space gets in use as area of settlement and infrastructure. After a while, current use is not needed any more because of changed external influences like structural change. Land gets abandoned for this use. At best, land could be transferred in a new use.

In many cases, old industrial or military sites are affected by soil and groundwater contaminations, position in town-structure and other influences. In consequence, Brownfields arise until a new use can be found. Procedure of Brownfield development for a new use is called revitalization.

Often, revitalization needs a long time. Therefore, in practice land can get an interim use. This interim use has to be flexible, because it has to come to terms with existent circumstances, has to be terminable and not to act in opposition to the purposed use.

For so called hardcore-sites it is not possible to revitalize land for a use as area of settlement and infrastructure. In this case, these sites are prepared as open space for increasement of urban quality of live.

Working group CLARINET (2002) (Contaminated Land Rehabilitation Network for Environmental Technologies) worked out four groups of influencing parameters for Brownfield

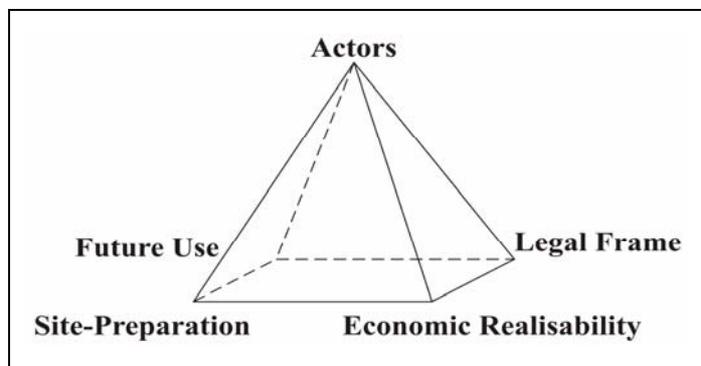


Fig. 1: Influencing Factors on Revitalization

revitalization. They call them: preparation of site, economic realisability, future use and legal frame. They illustrate these four parameters as edges of a tetrahedron. All of them are weighted equal, which is presented by same length of edges and the dimension of areas.

These parameters have to be completed by participants. In addition to tetrahedron-model, a pyramid symbolizes the balance of parameters

(see Fig. 1). Participants stand above and rule the project. Even if they weighted as the other parameter groups, they have to coordinate and cooperate project.

##### 4.1 Future Use

At beginning of revitalization stands the idea of an efficient new use for the site. FERBER et al. 2005 characterizes this development vision as “motor of project“, which affects revitaliza-

tion from the very first. Concept of development and new use attaches to this vision and embraces the whole project. Determination of influencing factors is important for a realistic imagination of project. Base is an inventory including a discussion of area's situation. Ownership structure has to be identified as well as area size and situation of infrastructure, urban targets and neighbourhoods. For economic calculation, land value before and after revitalization has to be detected. Especially for Brownfields, site history has to be acquired (Ferber et al. 2005).

In summary, it is important to detect large-scaled as well as small-scaled site-related factors, to judge demand and to establish possibilities and hindrances of the site (Eisele et al. 2001).

## **4.2 Site-Preparation**

Site-Preparation includes miscellaneous technical sections. With their involvement, revitalization could be proved. Support in risk and remediation assessment as well as remediation planning is needed for decisions concerning the dealing with contaminations and old buildings. Interaction with contaminations could mean safeguarding or remediation.

A well done site-preparation includes a risk evaluation for men and environment just as well as compilation of restrictions for the future (based on contaminations and lack of sustainable underground). This evaluation includes ecologic value and historic relevance and flows in suggestions for possible use of site (CLARINET 2002).

Furthermore, a well-done preparation with infrastructure is needed for a sustainable development. Brownfields benefit from functional external infrastructure. If necessary, external infrastructure has to be extended. The old internal infrastructure is not useful for normal cases.

## **4.3 Legal Frame**

Legal frame for revitalization of Brownfields embraces planning, water und environmental law. Moreover, legal frame for liability and tax has to be regarded.

Especially planning law offers a lot of instruments of building code available for inner-city projects in Germany.

Legislator offers two land use plans in Germany: preparatory and binding land use plan. The first plan shows in basic form type of land uses for the whole municipality in accordance with the intended urban development which is proposed to correspond to the anticipated needs of the municipality. The second plan presents legally-binding designations for urban development and has to be developed from preparatory land use plan.

If use will be changed, municipality has to modify preparatory land use plan for part of site and to change or prepare binding land use plan. If an investor wants to develop the site, he could make a project and infrastructure plan on which base municipality may employ a project-based binding land-use plan. Therefore, investor has to sign an implementation contract about fixed time-limit and to bear either wholly or in part the costs of planning and of the provision of public infrastructure.

Basically, the instrument of urban development contract between an investor and municipality is available. For Brownfield revitalization mostly contracts about infrastructure, exposure to contaminations and bearing of costs are common. For development of inner-city sites, leg-

islator offers instruments of Urban Development Measure (UDM) or Urban Redevelopment Measure (URM).

In UDM, building land is produced by land acquisition and development of municipality. The instrument offers the possibility to act against (former) owner's wishes and maybe to expropriate land. This instrument is suitable for large areas, but conditional, public interest requires consistent preparation and speedy execution.

URM is used for areas with urban deficits, which should be improved or rearranged. Brownfields could be characterized as urban deficit. This instrument is in particular interesting because of its founding possibilities.

Besides formal instruments, a lot of informal and private instruments exist. Especially combinations in form of Private-Public-Partnerships stand for high prospect.

#### 4.4 Economic Realisability

Revitalization is bound to high costs. Complex situations, technical problems and different interests cause high risks and are only difficult to calculate. Budgets and founding are reserved for special cases or areas in Germany. Lacks of founding and failure in project complicate calculation.

On closer examination of economy, three main types of Brownfields could be detected:

- **Self-developable Brownfields:**  
are usually characterized by local or regional importance. Value of property is high and costs for remediation are low. Besides, potential of development is high. Development includes value enhancement without need for public founding or change of planning law.
- **Passive-developable Brownfields:**  
are normally characterized by local or regional importance but accompanied by a certain amount of risk. They need help and assistance in planning and founding. Public-Private-Partnerships present an effective possibility for development because of shared risk and coordination in planning and financing.
- **Undevelopable Brownfields:**  
offer no potential for development in foreseeable future. Usually, these sites are located in mono-structured industrial regions. Neighbourhood is characterized by high density of Brownfields, which is a big problem for whole region. A low site-value is connected with high remediation costs. An autarkic development is not possible (CLARINET 2002).

#### 4.5 Participants

Concerned participants play a decisive role in developing Brownfields. Miscellaneous participants must be integrated in the process. Depending on the project, participants appear in different combinations: one or more (former) owner, new owner or prospective buyers, municipality, public agencies, public, developer or investor, development companies, planer, bank or insurances. It is possible, participants are not involved whole duration of project.

Success is defined by good collaboration, teamwork and participants' willingness to compromise. A good project management is indispensable, so different activities could be

coordinated and harmonised because of own views and individual targets of each group. Human factor plays an outstanding role.

#### **4.6 Weighting of influencing factors**

Several influencing factors, which had been grouped in section before, can be analysed, if they are correlated with land value increase. Land value increase is a measurable quantity, which indicates success of project. If increase is higher than costs, profit is realised. The higher increase is predictable the higher interest of investors will be.

Results of analysed studies are a dependence of land value increase on position within municipality, new use, costs for public utility facilities as well as begin of abandonment, type of remediation and complexity of inner public infrastructure.

In the context of frequency analysis of data follows conclusion, most frequently new use is habitation, commercial and mixed use with habitation, services and retails and sometimes commercial. Sites had no need for use as industrial area, so a new use is initiated. Habitation is realised normally on sites with few contamination, which are positioned in inner-city areas. Good positions are needed because of sensitive use and high costs for remediation involved. The land value increase, which is needed, is reachable only for inner-city. So position plays a decisive role in revitalization.

By revitalization, land value increases. Land value level of the analysed sites is lower than 50 €/per sqm before revitalization for 70 % of sites. After revitalization for 50 % land value is more than 100 €/per sqm. Especially for habitation, highest increases are (50 - 470 €/per sqm) obtainable. Also mixed uses with integrated habitation areas benefit from high land values after revitalization.

### **5. CHANCES AND HINDRANCES OF REVITALIZATION**

Many reasons hinder the development. Biggest problems are usually contaminations and other impairments like buildings and facilities. Furthermore, declination between land value of rural and urban area encourages investments in Greenfield. National economics cannot be monetarily quantified like lower costs for outer-urban land. Thus, development of Brownfield sites does not present itself as attractive for investors as it should be in view of land consumption and capacity of Brownfield sites.

Beyond this, ownership and liability maybe open or negotiation between owner and interested investor could be difficult. Revitalization implies ownership of concerned area, but misconceive of land value by former owner effects missing availability of land.

In many cases, it is not possible to open up new branches for abandoned sector, because of oversupply of derelict land in these regions. Only for a few sites, a new sustainable use could be found there.

Furthermore, as habitation revitalized Brownfield sites suffer from there stigma. They are afflicted by negative image. People do not trust remediation and are afraid of unknown contaminations. Evaluators know this problem as “decreased commercial value”.

Besides all these problems, Brownfields afford many chances. Revitalization provides possibility to solve problems of areas with overlapping land uses or land use conflicts. They are characterized by their good position in city where planning law often exists. Negative effects

of Brownfields on neighbouring area could be eliminated. Therefore, investments concerning the neighborhood of Brownfield sites usually follow revitalization (Koll-Schretzenmayr 1998).

Development by Public-Private-Partnerships has best prospects of success. Municipality does legal planning and investors do financing - often accompanied by founding.

Revitalising derelict land and abdicating of developing open space reduce land consumption, which has to be marked as biggest advantage for national economics.

## 6. TRANSFORMATION IN INDUSTRIAL PARKS

For investors, revitalization in view of habitation is lucrative. Habitation sites have higher land values, so profit margin is bigger than for revitalization in view of industrial sites.

Sometimes, revitalization in view of habitation is not possible, because of strong contaminations, position of site in an industrial area or oversupply of habitation sites in municipality. Besides, plant sites are not profitable any more. As a result, site would get abandoned. For these conditions, possibility of industrial parks exists in Germany.

*„Industrial parks are site-specific, industrial used facilities, where multiple legally autarkic companies are positioned on a small space. They work together in close network of deliverable and performance and use park typical structural facilities in common [...].”*

(according to Mückenborg 2003a)

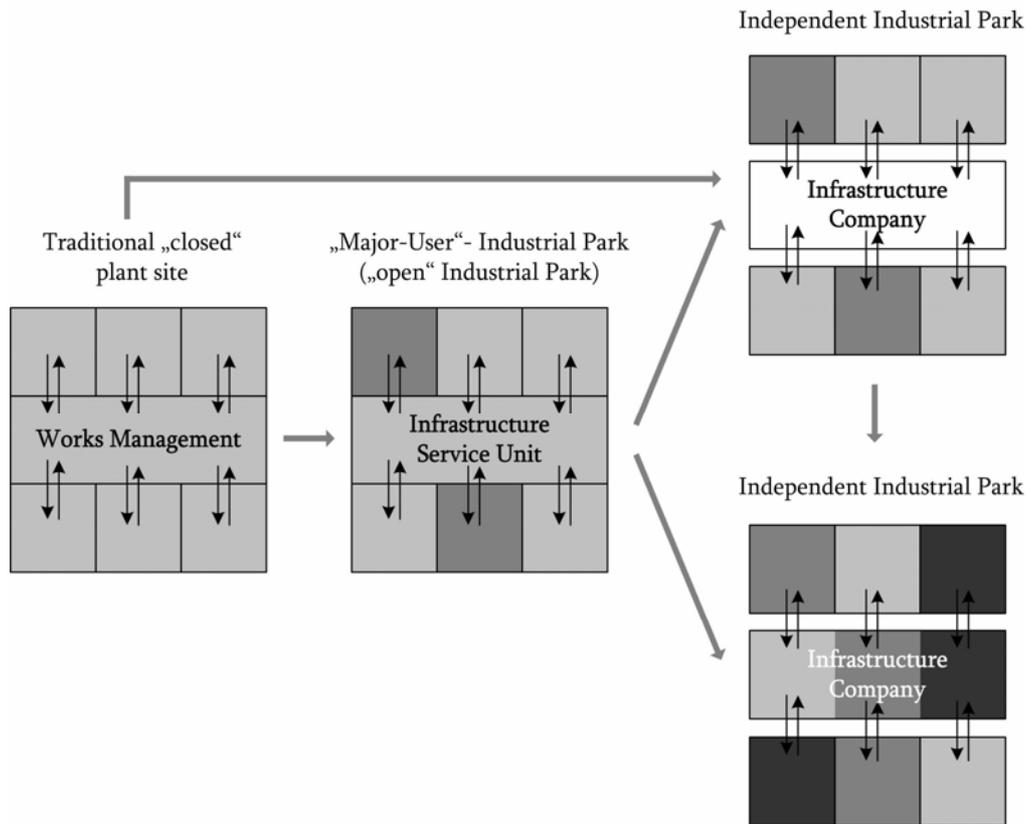
Especially by “close network of deliverable and performance”, industrial parks differ from trade parks. In an industrial park normally companies are located, which are situated in the same production process and deliver each other. Chemical parks present a sub-category of industrial parks with origin in chemical plant site. General tendency goes to a branch mix within parks (Mückenborg 2003a).

### 6.1 Organization forms

The origin organisation form (see Fig. 2) is a traditional closed plant site. Production and maintenance is done by self dependent work management. Only one company exists on site. Next stage is a “Major-User”-industrial park. It is an open park with different companies on site. An infrastructure service unit from “Mayor-User” runs infrastructure (Jochum 2003).

So-called infrastructure service units assure organisation in parks. Property is hold by operating company, which are often the former plant owner. The users normally lease their area. Disposal or hereditary rights to erect buildings on the land of plant owner are exception (Mückenborg 2003a).

Further development is an independent industrial park with two possibilities for serving the infrastructure company. As in “Major-User”-industrial park different companies work on site. Either the infrastructure company is legally and economically interdependent. Organisation of site is done by industrial park coordinator. Or infrastructure company is run by shareholder. Shares are hold by most important investors (Jochum 2003).



**Fig. 2:** Organisationforms of Industrial Parks (according to Festel 2004)

## 6.2 Advantages of transformation in industrial parks

Organization as industrial park means advantages for both operator and user. Operator has the possibility to share costs of infrastructure. Reserves of land as well as facilities like power stations, waste disposal, streets, services, cantinas etc. could be used more efficient. Operator has possibility to concentrate on core business, to abandon unprofitable business and to cluster resources. Higher demand enables better conditions (e.g. energy prices).

Advantage of users is saving costs for holding infrastructure. Another benefit is shorter ways for supplier, because of trading predominantly within park. Some users favour an equal industrial park logo or layout.

Besides advantages of operator and users of industrial parks, public benefits from this transformation as well. Alternation in industrial parks reduces the land consumption and the arising of Brownfields is prevented. For the most part, customer and delivery traffic takes place within park, so public traffic area is saved. Customers approve bundling up different activities at one place.

## 7. FUTURE PROSPECTS

Revitalization of Brownfield hinders or minimizes land consumption. A consequent inner-city development offers area without consuming Greenfields. Influencing factors are decisive regarding success or failure. It is important to understand their effects. So they could be used for interaction within project and finally to force success.

Nowadays, declination between land value of rural and urban area still encourages investments in Greenfield. Therefore, development of Brownfield sites does not present itself as attractive for investors as it should be in view of land consumption and capacity of Brownfield sites.

Future aim is a better understanding how influencing factors work. With this knowledge, a revitalization could be made more attractive for developers and encourage the transformation in industrial parks wherever applicable.

Why is this a mission for surveyors? Surveyors' inherently work is handling property by cadastre, land management and evaluation as main themes in Germany.

Circulation of land use is part of land management. Land management's basic function was reallocation of land in rural or urban areas for a long time. Especially reallocation of land in urban area implicates production of new building land.

Now situation has changed. In order to avoid land consumption, building land is still needed. Therefore, revitalization of Brownfields with its problems in land management and evaluation is the changed mission for surveyors. For instance, evaluation is needed for a solid calculation especially if founding is received. Knowledge of land management is needed for planning in particular for change of land use, questions of ownership, provision of infrastructure etc.

Working field of surveyor changed but got more interesting. By their natural function as connectors between acting groups, surveyors have best chances to do a very good job in revitalization of Brownfields and in supporting circulation of land use up to complete functionality.

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## **BIOGRAPHICAL NOTES**

Academic experience: Dipl.-Ing. geod., Graduate Civil Servant for Surveying and Real Estates (Assessorin des Vermessungs- und Liegenschaftswesens)

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