The Effect of Visual Damage of Landscape on Vacation Property Sales

Pekka RAHKILA and Eero CARLSON, Finland

Key words: Property valuation, visual damage, neurocomputing, valuation proceedings

SUMMARY

It has been found that visual damages caused by e.g. land excavation areas and power lines have distinct lowering effect on the values of vacation properties. In this research eight chosen problematic landscape objects and their visual impacts have been analyzed especially for expropriation purposes.

The valuation was based on neurocomputing. The system is also known as Self-Organizing Map (SOM) or Kohonen Map. Teuvo Kohonen introduced this computing technology in 1982 (Kohonen 1997). SOM-method is different from the traditional statistic models when valuating e.g. real estates. It has however been found to be a flexible tool for analyzing multivariate data. Thousands of scientific papers, based on Kohonen's theory, have been published dealing with different applications in engineering, finance and medicine.

In this research work all the vacation property sales, in two consecutive years, have been analyzed in connection with distances from the mentioned troublesome landscape objects. Sales, here called observations, are organized as a usually two-dimensional hexagonal lattice of units. Observation vector contains all the desired components (including price and location) and the corresponding reference vector in the unit of the map is averaged from resembling observations in the neighborhood.

The general opinion is that the nearer the negative object is, the stronger is its effect on the price of the parcel involved. What are the distance-price trends in various cases? That is why nearly 12 000 observations were computed using the digital map data and the corresponding data from Real Estate Market Price Register. Deviation profiles were computed using SOM - application. Resembling sales are organized as valuations and actual sales prices are compared to their valuations according to the distance from the chosen landscape object.

The purpose of the study has been to get a practical tool to valuate aesthetic landscape damages caused by various ventures. These ventures belong normally to constructions of infrastructure and their negative impacts have to be handled and compensated in connection with statutory survey transactions.

The Effect of Visual Damage of Landscape on Vacation Property Sales

Pekka RAHKILA and Eero CARLSON, Finland

1. INTRODUCTION

More often, in connection with legal cadastral surveys, it has been found that land surveyors have got into handling various aesthetic values. These valuation cases have come forward combined with legal valuation proceedings. These operations incorporate most often in surveys based on the Public Road Act (MTL), the Expropriation Act (LunL) and the Land Extraction Act (MAL). In all these three cases handling is happening according to the provisions given in LunL.

When thinking of road constructions, erecting of power lines or excavating of gravel or blasting of rock, original landscape is changing. We can say that ventures belonging to the construction of our normal infrastructure may deteriorate somebody's landscape or view.

Our Finnish case law is such that the landscape opening to our view, out of our parcel, is a part of the value of our property. That is why all economical losses caused by the above-mentioned ventures should be compensated. According to the Finnish Constitution Law, compensations for the mentioned losses shall be made based on the principle of full compensation. In some cases compensations shall be handled on the ground of a law, sometimes only on the demand of the party who sees to have lost something because of the venture going on.

The main questions from the point of view of the land surveyor are as follows:

- Does the damage have adequate causal connection with the venture going on?
- Does the damage point to the protected living surrounding of the party who has suffered damage?
- What is the situation compared with the general habitual character of the area in question?
- Could the situation and the damage have been prejudged beforehand?
- Is the damage such that it exceeds the compensation threshold?
- And finally how to estimate the monetary value of the total damage?

2. RESEARCH

To unravel the characters of various visual damages combined with their monetary effects, eight prominent negative objects in landscape and scenery were chosen. Distances between the damage objects and real property sales were determined from the digital map data of the National Land Survey. The used real property sales data contained all the transfers of vacation properties of two adjacent years. The total amount included 11804 sales.

Public opinion is that the values of vacation properties are sensitive to all disturbances in landscape or in vista. In other words, the closer any disturbing object is to the mentioned parcel, the greater should be the price effect.

The eight disturbing or negative landscape object which were examined were: 1) motorways, 2) main roads, 3) gravel and sand pits, 4) open quarries, 5) fences and walls, 6) road embankments, 7) high voltage power lines and 8) cell phone towers. The effect of power lines was analyzed beforehand, using the same data, and the results are published in the net publication (Carlson 2003). These results were also taken to comparison with the other seven objects.

Using neurocomputing by the help of Kohonen Map (Kohonen 1997) property sales observations were organized as valuations from resembling sales and as groups from neighboring sales. Deviation profiles were computed according to distances from the above-mentioned eight disturbing objects. The final results were given as comparable curves and as tables (Carlson, Rahkila 2004).

2.1 Landscape

How to determine "landscape"? It is difficult. Obviously more difficult is to give perfect presentation for the notion of "damage of landscape".

Our common European Landscape Convention (Florence, 20 October 2000), below, hopefully helps us to comprehend the meaning of the conception:

The landscape …
… has an important public interest role in the cultural, ecological, environmental and social fields, and constitutes a resource favorable to economic activity and whose protection, management and planning can contribute to job creation;
… contributes to the formation of local cultures and … is a basic component of the European natural and cultural heritage, contributing to human well-being and consolidation of the European identity;
… is an important part of the quality of life for people everywhere: in urban areas and in the countryside, in degraded areas as well as in areas of high quality, in areas recognized as being of outstanding beauty as well as everyday areas;
… is a key element of individual and social well-being and … its protection, management and planning entail rights and responsibilities for everyone.

According to the common convention "landscape" includes much wider meaning than visual only. First of all we naturally conceive landscape as geomorphologic formations, rocky hills, moraine hummocks and esker ridges.

Anyway that is not all. What we, at the same time, hear belongs to the same entity. Songs of the birds, traffic noise, voices caused by rock blasting are part of our auditory landscape.

At the vicinity of motorways we feel the vibration caused by the heavy traffic. The effect of rock blasting is easily perceptible even a bit farther. Don't forget the soft touch of wind. All what we sense, belongs to the one and same landscape.

At the same landscape we also smell various scents, good (fragrance of flowers) or stinking smells of exhaust rock or smell caused by land extraction activities.

Landscapes contain also psychic elements. Its beauty can encourage us in many different ways. When it is familiar, it seems unchangeable and protected. When construction of a power line nearby it can break down our environment. We possible may start to fear cancer because of the magnetic field caused by the line.

All objects mentioned belong as parts to the same complicated entirety of landscape. It contains both good and not so good features. A land surveyor is the civil servant who should be able to valuate that landscape and all possible damages referring to it, from the economical point of view in all imaginable circumstances.

2.1.1 Bedrock and landforms in Finland

The Finnish bedrock is mainly composed of crystalline plutonic rocks, granite and gneisses. We can also say that the bedrock mainly gave forms to our landforms. Apart from the relief of the bedrock, other landforms are low; relatively heights are less than 75 m. Only some longitudinal eskers may exceed that limit.

The bedrock is fractured, with fissures and faults. During the Ice Age, the fracture valleys, parallel to the flow of the continental glacier, were peeled of their unconsolidated products by the movement of the glacier. These originally fractured rock valleys are nowadays covered by water. Thus our lake basins mainly follow the NW-SE-direction of the movement of the continental glacier. Lake basins are sometimes lined with longitudinal eskers and moraine formations, drumlins. These landforms are directed to the same NW-SE-direction.

We can summarize that Finland is rather flat country. Its relief is mainly formed by bedrock and partly also glacigenic and glaciofluvial landforms whose relative heights are often only some tens of meters.

2.1.2 Human influence upon landforms

Various human activities are increasingly changing and reshaping these ancient landforms. In the context of this research we were especially interested in the landscape effects of rock and of gravel extractions. Road and house construction activities are requiring large amount of gravel, sand and aggregates. Firstly land material has been taken from eskers and from ice-marginal formation. The have been the easiest areas to exploit.

In the southern parts of the country many eskers and moraine formations are already fully exploited. Landscape seems to contain open or reshaped gravel pits. According to the Land

Extraction Act, gravel extraction needs a permit from the municipality authorities and after-treatment of the fully extracted pits is obligatory. This hopefully helps to concentrate extraction activities to reasonable areas and also to maintain tolerable landscape.

After the gravel and sand resources have been exploited, extraction of rock aggregate has fast been increased. The material volumes covered by permits for rock extraction have been increased 35 % since 1994. There are however big regional differences. In the southern part of the country much larger amounts of rock products than gravel and sand are exploited (Rintala 2006).

There are distinct visual effects in these land excavation areas. Firstly the primary natural landscape will be, little by little, lost. This is against the widely accepted idea that "every untouched corner in the nature is beautiful". Removing of a rocky hill or an esker may open a new view. It is possible more unaesthetic than the original one. In the worst case behind the primary formation may open up a view on a waste tip!

Secondly, loading of gravel and sand often raises clouds of dust. The effect is the stronger the drier the weather, the heavier the wind and the more silt and fine sand is including the extracted material. The dust effect is still worse near the open quarries where rock aggregate is extracted by blasting and crushing. Dust from blasting and aggregate production is fine and needle-sharp (Räisänen 2004).

Dust from crushed rock seems to be both smearing and when breathing unhealthy. Johannes Guo has found increasing risk of lung cancer among those exposed to silicic rock dust (Guo 2005). Roughly 2/3 of the mineral content of Finnish Precambrian bedrock, which has increasingly been started to crush, is just silicon oxide (SO_2).

Thirdly, it is well known that land extraction areas are noisy. The most prominent noise is caused by rock blasting and crushing of blocks and stones. Loading and transporting are also causing their extra noise, although it is less disturbing. Every now and then on neighboring parcels can even be sensed vibration, caused by rock blasting. In bad cases vibration may cause joints in the basements of nearby buildings.

Fourthly, when protecting rocky hill or esker ridge is removed, local microclimate can alter. Northern winds can possibly swirl in the areas, which earlier were located on southern lee-sides of the hummock.

Fifthly, we have found that land extraction can lower groundwater level, change its flowing directions and sometimes change its quality attributes. There may also be some other indirect effects that can be connected with land extraction processes (Rahkila 2000).

2.2 Expropriation survey and land extraction area

In cases when land extraction area has presumably diminished the value of the nearest property or any other nearby property, their owners can apply an expropriation procedure to settle the question. The written application is based on the 9§ of the Land Extraction Act.

The District Survey Office appoints a land surveyor to do the expropriation procedure. Expropriation committee, land surveyor and two trustees, with the applicant and other parties concerned make possible field check and handle the question on the base of the law. The final expropriation judgment includes e.g. who will pay, what and to whom? And also what are the grounds of the judgment.

The damages of any landscape are complicated and appearing in many forms. That is why it is not easy to find so-called "correct" result that would satisfy both the applicant and the one who is liable to pay. According to the above 9§ of MAL, liability for compensation is ordained in accordance with quite "roundish" compensation threshold. It determines the situation so that land extraction should cause such diminish to the value of the property that can't be considered slight.

Various losses caused by various land extractions are necessarily based on, more or less, rough estimations. That is why these legal surveys and assessment proceedings are often appealed to the Land Courts. In theory the decisions made by the Land Courts can be appealed, onwards, to the Supreme Court. The applicant however needs the special permission to appeal. It will be granted if there are special grounds to continue the case in question. In practice the final judgment, as a rule, has been the one made by the Land Court.

2.3 SOM-method in valuation of damages of landscape

Dr. Teuvo Kohonen firstly introduced Self-Organizing Map (SOM) algorithm in 1982 (Kohonen 1997). Mr. Eero Carlson has later developed Kohonen's method for real estate valuation purposes. In this application real property sales data is accompanied with topographic information of the environment and building data from Population Register Center of Finland. Sales prices and the effects of individual components are analyzed. The whole application is published in Carlson's net publication (Carlson 2003).

The sale prices of real estates, i.e. **observations** are coded and scaled and finally organized into valuations and groups. Special emphasis is given for the locations of observations. **Valuations** contain the group of about 20 resembling sales with reasonable scaled components. Valuation includes e.g. averaged values for the components of the real estate data in question, typical sales price and the information of six nearest valuations.

Neighboring sales organized as a unit of Kohonen Map using geographic coordinates only is termed a **group**. It contains roughly 20 neighboring sales. It includes also the averaged values for the components of the nearby real properties, averaged sales price in the given location and the information of six nearest groups.

Local sales price undulations can be computed using groups. Actual sales price in the neighboring observations are compared to the matching valuations and the average sales price ratio or difference is recorded in the group. Local undulations can be clearly found. All kinds of real properties in a given location are compared to their valuations from resembling sales in a wider neighborhood and the difference indicates all positive and negative characteristics in a given location.

SOM-method is applied in this research so that resembling sales were at first organized as valuations and then compared to the vacation property sales according to the distance from the eight chosen, obviously negative, objects. The computing was made up to the distance of 3000 m for every chosen object. Finally the deviation profiles as curves and as tables were produced.

Local sales price undulations were taken into account. Only the additional deviation is shown in the profiles. This means that e.g. in connection with gravel pits there appeared average negative undulation of three percent up to the distance of 200 m. Close to the pit the profile shows the negative deviation of 13 percent. Thus the total negative deviations close to the gravel pits are 16 percent compared to resembling observations in the wider neighborhood (Rahkila et.al. 2006).

3. RESULTS

3.1 Distances from vacation properties to gravel pits and the sales prices

Gravel pits which are mapped on digital basic maps, are defined as follows (MTJ code 32111):

Minimum size of the object shall be 1000 square meters. Smaller objects can be recorded according to consideration. Areas for mining sand (three quarters), gravel (one quarter), moraine and fine sand (exceptional) are recorded.

From the total amount of 11804 observations there were 8630 useful observations within a distance of 3 km to the gravel pit. The observations are grouped according to the distance (meters) to the gravel pit. Actual sales prices are compared to the valuations in question. Both the average value of the ratios and the average sales price difference are shown as tables and as curves. The sales price ratio and difference in the group of neighboring observations was taken into account.

Some short remarks: Comparable sales are found also in the vicinity (average 1.6 kilometers, fourth column in table 1) of the gravel pits. An overall negative effect of about one percent is seen up to the distance of three kilometers, about two percent up to distance of 700 meters and about three percent up to distance of 200 meters. This effect is eliminated in the figures and on the table.

Quality differences in sales objects can be interpreted by the help of the table information. For example the sizes of lakes seem to be smaller close to gravel pits. Recreational parcels also seem to locate the farther from the lakes, the nearer gravel pits are situated.

Negative deviations up to average 10 percent were seen up to 400 meters from the gravel pit. Overall negative effect of one to three percent up to 3 kilometers obviously indicates that the best recreational areas do not belong to the neighborhood of land extraction areas.

Remarkable positive and negative deviations are seen at all distances from the gravel pit. Negative deviations are more prominent up to the given distance. Average deviation means the level of the differences in typical cases especially in the vicinity of the gravel pit. Overall effect includes in addition to all other positive and negative components the analyzed component self, too. Overall negative effect of two or three percent may in this case be caused by the gravel pit self.

Table 1. Distances from gravel pits and the corresponding sales of vacation properties. Columns from the left: *Distance* (from gravel pits), *obs* (amount of observations at the distance), *m* (mean distance of observations from the gravel pits), *res km* (mean distances of resembling observations), % (ratio between actual sales and valuations), *diff* (difference, in 1000 FIM, between actual sales and valuations), *price* (average price of properties), *year* (average year of construction), *size* (size of the building in m^2), *bui* (amount of built parcels in %), *are* (parcel area in 100 m²), *pla* (parcels in planned areas in %), *par* (amount of parceling out observations in %), *lsi* (size of the lake in sqrt of the water area) and *sho* (index for closeness to shore; 100 = own shore, 10 = far from a shore).

distance	#obs	m	res km	%	diff	price	year	size	bui	are	pla	par	lsi	sho
0..60	40	39	1.6	-13.1	-16	80	1965	13	42	70	2	38	33	62
0..120	121	73	1.6	-10.1	-10	105	1964	22	51	58	6	36	31	63
60..180	167	123	1.6	-8.0	-7	122	1960	30	59	52	10	31	27	62
160..240	156	204	1.6	-5.9	-6	119	1965	28	54	51	13	36	27	64
200..500	746	359	1.6	-4.4	-5	122	1964	27	59	52	8	31	34	65
300..700	1199	517	1.6	0.3	-1	131	1966	27	57	50	10	31	37	70
400..1000	2075	715	1.6	2.7	1	137	1967	25	56	50	13	32	39	72
800..1700	3298	1245	1.7	0.3	0	141	1967	26	56	49	12	31	43	74
1500..3000	3993	2160	1.9	-2.0	-1	149	1965	27	56	49	14	31	48	76

Cognitive significance of a gravel pit emerges:

- As noise and vibration. Excavation operations cause considerable noise in the vicinity. The noise is temporally irregular and more annoying compared for example to a main road. Irregular stone crushing prominently adds noise and vibration effect.
- As unaesthetic view. The heights of the man made banks can be from 5 to 15 meters. The ratio of 1 to 100 means distances from 0.5 kilometer to 1.5 kilometers. Greater ratios may be seen in the sales prices.

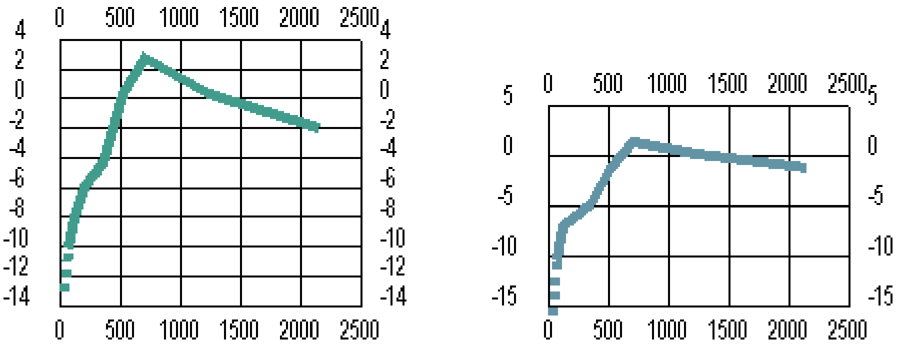

Figure 1. Price ratio in % (left) and price difference in 1000 FIM (1 € is about 6 FIM and price level is nearly doubled since the date of the sales data used in this research) (right) from table 1 in graphic form.

- As dust impact. Depending on weather and wind conditions dust impact can be very irritating. Block and stone crushing operations belong to gravel extraction activities. That kind of dust particles are sharper-edged and more dangerous compared to typical sand dust.
- Special geological and groundwater problems may also occur in connection with land extraction activities.
- Sand or gravel pits have usually good road connections for heavy traffic. Good connections indicate positive deviations in sales prices and this can be seen in the profile from 0.5 to 1.5 kilometers.

3.2 Distances from vacation properties to quarries and the sales price

Quarries also called stone pits which are mapped on digital basic maps, are defined as follows (MTJ code 32500):

Minimum size of the object shall be 1000 square meters. Only open-surface pits and quarries are recorded. The term means a surface excavation for extracting stone or slate.

The distances to the nearest quarry or stone pit were computed from the digital map in a similar way as expressed in chapter 3.1. Sales prices are compared to valuations from resembling sales organized using Kohonen Map.

From 11804 observations there were only 715 useful observations within a distance of 3 km to any quarry.

The observations are grouped according to the distance (meters) to the quarry. Kohonen Map is used to organize comparable sales as valuations. Resembling sales in the neighborhood give typical sales prices from usually 14 to 28 resembling properties. Actual sales prices are compared to these typical sales prices and both the average value of the ratios and the average sales price difference are shown in the table. The sales price ratio and difference in the group of neighboring observations is taken into account.

Comparable sales are not found in the vicinity of the quarry. An overall negative effect of one percent is seen up to distance of 2.5 kilometers and two percent up to distance of 2 kilometers. This is eliminated in the figures and in the table.

Differences in qualities are not seen in the vicinity of the quarry. For example the size of the lake and the closeness to the shore are comparable.

Negative deviations up to average 20 percent were seen up to 800 meters from the quarry or stone pit. Overall negative effect of two percent up to 2 kilometers may indicate that a quarry or a stone pit does not belong in the neighborhood of best recreational areas.

Remarkable positive and negative deviations are seen at all distances from the quarry. Negative deviations are prominent up to the given distance. Average deviation means the level of the differences in typical cases especially in the vicinity of the quarry. Overall effect includes in addition to all other positive and negative components the analyzed component self, too. On the other hand it is easy to understand that recreational activities avoid closeness of these noisy areas.

Table 2. Distances from gravel pits and the corresponding sales of vacation properties. See the explanations for the uppermost row on table 1.

distance	#obs	m	res km	%	diff	price	year	size	bui	are	pla	par	lsi	sho
0..800	42	545	2.8	-11.2	-2	135	1958	28	62	40	5	26	39	63
0..1200	99	826	2.8	-1.0	1	147	1958	28	58	48	10	28	42	70
500..3000	307	1416	2.8	1.6	0	146	1958	28	60	51	8	27	43	70
1500..3000	539	2327	2.9	2.4	2	149	1962	30	64	50	9	27	44	65

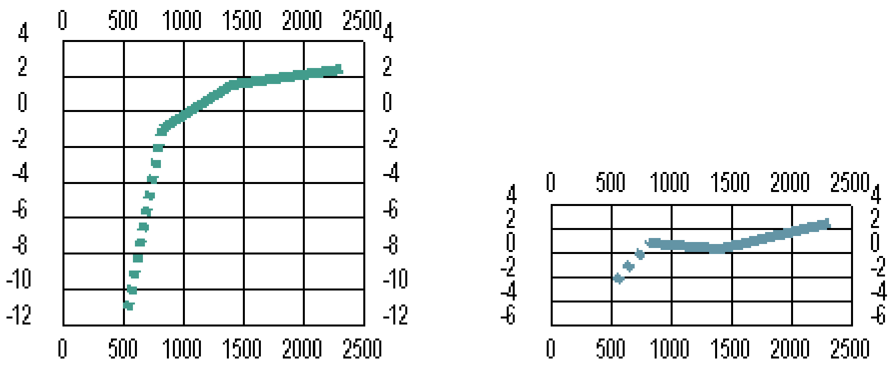

Figure 2. Price ratio in % (left) and price difference in 1000 FIM (1 € is 6 about FIM and price level is nearly doubled since the date of the sales data used in this research) (right) from table 1 in graphic form.

Cognitive prominence of the quarry emerges:

- As a noise impact. Blasting and crushing operations cause considerable noise in the vicinity. Noise is more continuous and more annoying compared for example to operations in gravel pits.
- As a vibration impact. Explosions connected with blasting of rock may often cause trembling effects in the vicinity. Vibration may sometimes be so strong that it has causes joints in the foundations of the nearby buildings.
- As a dust impact. Particles are often sharper-edged and in that sense more complicated compared to normal sand dust.
- As a visual impact. The heights of the walls are usually from 5 to 15 meters. The ratio of 1 to 100 means distances from 0.5 kilometer to 1.5 kilometers. Greater ratios may be seen in the sales prices. In the rock extraction areas there are often crushing machines and waste heaps that increase unaesthetic view, too.

4. FINAL REMARKS

The monetary meaning of various distortions in landscapes is analyzed. The research data consisted of the vacation property sales of two consecutive years. The research was made using the application of Kohonen Map. Resembling sales were organized as valuations. Price undulations were analyzed using the groups of neighboring sales.

Price landscapes are formed of physical and emotional elements. We sense our surroundings using all the five senses. A landscape is not only the visual opening as is meant in familiar language. Each of us also valuates and perceives her or his landscape in an individual way.

The results of this study give average deviations for the impacts of some concrete distortions in landscape. When arguing her or his judgments for landscape losses, by the help of these results, the grounds are probably more objective than without them.

REFERENCES

Carlson, E. 2003, Visual Explorations in Real Estate Market. Publication B 101. Helsinki University of Technology, Department of Surveying, Institute of Real Estate Studies. Net publication. [http://www.tkk.fi/Yksikot/Kiinteisto/julkaisut/verkkojulkaisut/carlson/]

Carlson, E., Rahkila, P. 2004, Landscape and Scenery – Recreational parcels in Finland. Publication B 109. Helsinki University of Technology, Department of Surveying, Institute of Real Estate Studies. Net publication. [http://www.tkk.fi/Yksikot/Kiinteisto/julkaisut/verkkojulkaisut/carlson2/]

Guo, J. 2005, Finnish national job-exposure matrix (FINJEM) in register-based cancer research. Finnish Institute of Occupational Health. People and Work Research Reports 69. Helsinki.

Kohonen, T. 1997, Self-Organizing Maps. Second edition. Springer, Berlin.

Rahkila, P. 2000, On handling of geological problems in connection with statutory survey transactions. Publication no 91 of National Land Survey of Finland. Helsinki.

Rahkila, P., Carlson, E., Hiironen, J. 2006, Maisemahaitoista ja niiden käsittelystä maanmittaustoimituksissa. Maanmittauslaitoksen julkaisuja nro 99. Helsinki.

Rintala, J. 2006, Extractable land resource volumes and permits 2004 – extraction areas under the Land Extraction Act. The Finnish Environment 818. Finnish Environment Institute. Helsinki. (The publication is in Finnish).

Räisänen, M. 2004, From outcrops to dust – mapping, testing and quality assessments of aggregates. PhD-thesis No. 179 of the Department of Geology, University of Helsinki.

BIOGRAPHICAL NOTES

Eero Carlson obtained an M.Sc. in Engineering at the Helsinki University of Technology in Finland in 1970. Since 1973 he has worked on the development of a Finnish Geographic Information System (GIS) and since 1990 neural networks. His main interests are real estate appraisals with Self-Organizing Map (SOM, Kohonen Map) and the integration of SOM and GIS. Mr. Carlson is author of about 15 publications on neural networks.

Pekka Rahkila has obtained his M.Sc. in 1972, Dr.Tech. (in Cartography) in 1980 at the Helsinki University of Technology, M.A. (in Geology) in 1977, PhD (in Environment Geology) in 2000 and M.Th. (in Ecumenical Theology) in 2006 at the Helsinki University of Helsinki. From 1972 up to the early 90's he has been involved in developing the Basic Map and mapping of Quaternary Deposits in cooperation with Geological Survey of Finland. Since 1993 Dr. Rahkila has worked as a land surveyor in the District Survey Office of Häme. Since 1983 he has worked as a docent in cartography (Geomorphologic questions) at the Technical University of Helsinki and during 1984-86 at the University of Zambia. In 2006 he is the chairman of the Finnish Society of Surveying Sciences. Dr. Rahkila has also had been interested in pastoral questions of everyday human life and he has worked as an ordained, part-time, pastor and theologian in the Lutheran Church since 1993.

CONTACTS

Eero Carlson
National Land Survey of Finland
P.O. Box 84
FI-00521 Helsinki
FINLAND
Tel. + 358 20 541 5183
Fax + 358 20 541 5070
E-mail: eero.carlson@nls.fi
Web site: www.tkk.fi/Yksikot/Kiinteisto/julkaisut/verkkojulkaisut/carlson/carlson.html

Pekka Rahkila
National Land Survey of Finland
P.O. Box 117
FI-13101 Hämeenlinna
FINLAND
Tel. + 358 20 541 4246
Fax + 358 20 541 4200
E-mail: pekka.rahkila@nls.fi