Location is Crucial in Retrofit: Strategy Selection in Different Regions

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Abstract

Purpose – Existing old building stock needs retrofit of structures and performance upgrading. Retrofit is often neglected, either lacking understanding of maintenance importance or to keep living costs low. Retrofit is inevitable. Depending on a buildings geographical location, condition or expected time of use; demolition of building or increment space is worth considering. This study looks at the economics about which is the best option: renovation and energy efficient upgrading of existing building or replacement of existing building.

Design – Research method is case study. The same case building – size, age, existing performance as well as renovation and new performance – studied at different regions. These are (1) growing city, (2) stable city and (3) shrinking city. Life cycle cost analysis bases on payback periods. The most important input data are the rent and occupancy rate on each area.

Findings – In growing cities, both renovation and replacement of existing buildings are feasible options. In other two areas, payback periods of renovations are rather long and acceptable only if building is in own use. Often retrofit is necessary because of the poor condition of the building.

Research Implications – This study looks at the subject only from building owners economical point of view and ties building to its location. Life cycle assessment (energy use and greenhouse gas emissions) has analysed earlier (Nippala and Heljo, 2010).

Practical Implications – Analysis gives the most feasible option to different regions.

Originality – This study raises the debate on how realistic it is to expect the building stock to meet the EU's energy saving and greenhouse cut targets.

Keywords New building, Renovation, Demolition, Profitability, Payback, Housing

All papers within this proceedings volume have been peer reviewed by the scientific committee of the 10th Nordic Conference on Construction Economics and Organization (CEO 2019).

1. Introduction

At the turn of the millennium, lively discussions began in Finland on the status and future of suburbs built in the 1960s and 1970s. Some exceptionally expensive renovations raised these

Emerald Reach Proceedings Series
Vol. 2
pp. 463–469
Emerald Publishing Limited
2516-2853
DOI 10.1108/S2516-28532019000002005

discussions. A public debate was held on whether it was worth repairing residential buildings located in suburbs. In addition to high renovation costs, the demolition of residential buildings in suburbs was justified by referring to unrest and insecurity in such neighbourhoods, and the buildings' low energy efficiency and monotonous architecture. Residents disputed these claims and were prepared to stay in the suburbs, even if a change of residence would have been timely (Strandell, 2004).

An energy-efficiency comparison showed that it would take 25 years for the lower energy consumption of new buildings to repay the cost of demolishing old ones and the energy used to produce the building materials and perform the required construction. In the case of a new, low-energy building, the payback period would be shorter, at 15 years. If a renovated building had been used rather than the original building as the basis for calculating the payback period, the calculated energy payback period would rise to 45 years (Nippala and Heljo, 2010). In addition, the Ministry of the Environment (Tahvanainen, 2010) has underlined the fact that the locations at the centre of the controversy are so-called experimental ones. Normal renovations cost only 30-40 per cent of the price of new construction.

The "Is renovation viable?" debate was revived ten years later, but this time, the focus was on apartments owned by private housing companies, rather than social housing. The debate was triggered by issues such as the requirements of the European Union Energy Efficiency Directive and the Energy Performance of Buildings Directive for the improvement of energy efficiency in existing, old buildings. Combined with other statutory renovations, energy efficiency targets (particularly plumbing renovations) make renovations of old buildings expensive.

Based on their reputation for solvency, Finnish housing companies have found it easy to obtain renovation loans. However, there have recently been cases of loans being denied because renovations were considered too costly compared to the building's value, particularly in areas affected by population loss.

2. Objective

The objective was to ascertain, from an economic perspective, whether the renovation and improvement of the energy efficiency of an old building, or its demolition and replacement with a new building, are financially viable in three different regions.

3. Study design

3.1. Description of cases

The case study compared the renovation and improvement in energy efficiency of a typical residential block representative of the 1970s to its replacing with new building.

Energy savings, residual value and rental income were recognised as offsets to the above costs. The content and costs of the renovation were based on real, market-based renovations (EU-GUGLE, 2018).

The package of measures consisted of additional facade insulation and rendering, new windows, re-plumbing, an exhaust air heat pump and building energy management system. The costs of new construction represented normal housing production, to which the costs of demolishing the old building were added.

The study took account of the form of housing tenure. The building was therefore assumed to be either A) owner-occupied or B) owned by a real estate investor and occupied by tenants.

Cases were investigated in three different regions: Area 1 in which the population is growing strongly and there is demand for housing; Area 2 in which the population remains

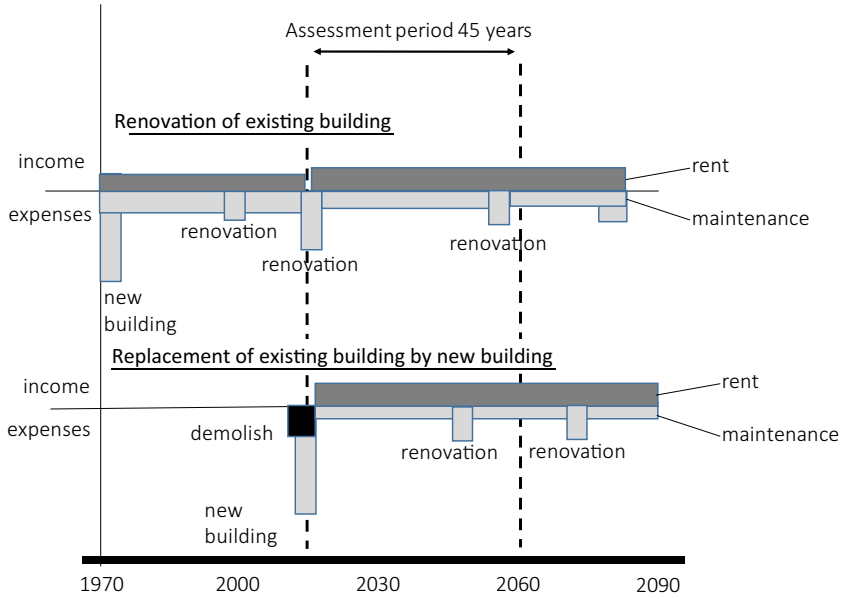

Figure 1.
Studied Options

unchanged and housing demand is stable; and Area 3 in which the population is declining and homes may lack permanent residents.

3.2. Description of regions

Area 1 is a large city whose population has grown by 30 per cent between 1990 and 2015 and has an average age of 40 years. The population is expected to grow by 15 per cent by 2040. The average earned income of residents in the area is EUR 27,000 per year and unemployment rate 14.6 per cent. On the basis of average income, the area is more prosperous than the Finnish average.

Area 2 is a small town in the economic area of a large city. Its population increased by 4 per cent from 1990 to 2015 and its average age is 45 years. It is anticipated that the population will remain unchanged in 2040. The average earned income of residents in the area is EUR 24,000 per year and unemployment rate 11.2 per cent.

Area 3 is located in the countryside, relatively far from thriving cities. The area's population declined by 15 per cent from 1990 to 2015 and its average age is 45 years. The population is expected to decline by 15 per cent by 2040. The average earned income of residents in the area is EUR 25 000 per year and unemployment rate 14.3 per cent (Statistic Finland [2015]; Statistic Finland [2018a]; Statistic Finland [2018b]; Ministry of economic affairs and employment [2018]).

3.3. Assumptions and variables

All values are either market prices or results of research projects. (ARA [2018]; Kauranen [2001]; Haahtela [2015]; EU GUGLE [2018]; Statistics Finland [2018c]; Statistics Finland [2018d]).

Variables	Unit	Area 1 Growing city	Area 2 Stable city	Area 3 Shrinking city
Assessment period	years	45	45	45
Rent, existing building	€/m²/month	17	13	12,5
Rent, new building	€/m²/month	20	15	12,5
Maintenance cost	€/m²/month	4,4	4,4	4,4
Occupancy rate, existing building	%	98	95	80
Occupancy rate, new building	%	98	95	80
Construction cost	€/m²	2,000	1,800	1,620
Renovation cost 2015	€/m²	1,076	969	872
Renovation cost 2045	€/m²	400	400	400
Renovation cost 2050	€/m²	500	500	500
Energy saving	€/m²/month	4.2	4.2	4.2
Demolition cost	€/m²	142	142	142
Residual value 2060, new	€/m²	900	900	900
Residual value 2060, old	€/m²	200	200	200

Table 1. Assumptions and Source Information of the Variables

4. Results

In **Area 1**, renovation existing building and replacing existing building by new building are both financially viable alternatives. The payback period for the renovation is eight years. The payback period rises close to 12 years for the demolition-and-new-construction option. However, from the investor's point of view profitability is vulnerable to interest rate rises or falls in rental incomes.

In **Area 2**, both the population and housing demand will remain stable in the future. The rental income is slightly weaker than in Area 1, but the expected rental income is reasonable. Both options – renovation and demolition-and-new-construction – are profitable from viewpoint of owner, but not viewpoint of investor. Payback periods are longer than in growing area.

In **Area 3**, the rental income is so low that neither renovation nor demolition-and-new-construction would be profitable from the investor's viewpoint. If the building is owner-occupied, i.e. in a building controlled by a housing company, renovation options are viable if the occupancy rate is 100 per cent.

	Area 1 Growing city	Area 2 Stable city	Area 3 Shrinking city
Basic payback time (years)	8	18	19
−10% in rent rate	+2	9	infinity
−10% in occupancy rate	+2	+5	infinity
+10% in renovation cost	+0.5	+1	+1

Table 2. Renovation of Existing Building

	Area 1 Growing city	Area 2 Stable city	Area 3 Shrinking city
Basic payback time (years)	12	13	26
−10% in rent rate	+2	+1	+20
−10% in occupancy rate	+2	+2	+20
+10% in new cost	+1	+2	+12

Table 3. Replacing Existing Building by New Building

Renovation would be worthwhile in all three areas, if the building is in the owners' own use. The repayment period is a reasonable from 8 to 14 years. The same payback period would also be achieved for investment targets in Area 1. By contrast, careful consideration should be given to real estate investment in Area 3, where the payback period extends to a quite long 13 years.

The demolition of the old building and new construction has longer payback periods than renovation. It is viable in all areas where the buildings are owner-occupied. However, as a real estate investment, this option is only profitable in Area 1, given the likely rent levels. There, the population is growing strongly and guarantees demand for housing.

In option "renovation of existing building" decrease of rental income or occupancy rate by 10 per cent causes at Area 1 only 0.5-2-year longer pay-back period. At Area 3 the same changes ruin the economy of the energy renovation. Only renovation cost growth by 10 per cent increase the payback period by one year.

In option "replacing existing building by a new building", decrease in rental income or occupancy rate by 10 per cent or 10 per cent growth of the new construction cost causes at Areas 1 and 2 only 1-2 year longer pay-back period. These regions are steady for these changes. In Area 3, the same changes cause dramatic change. Payback period increase by 20 years.

5. Discussion

The result of this study is in line with Swedish study of Million programme houses. It concluded that the most economically viable strategies for existing aged residential housing stock are the ones that contain renovating. Although these alternatives lead to investment costs, but they relatively soon is covered by earnings. At the same time, they give a low energy consumption, which with all confidence will be profitable in the future and gives the possibility for a low rent cost. The discussion investigates, which alternative is the most favourable for the tenants, and it seems to be the alternative renovate to passive house today (Dahlöf & Malmros, 2011).

Profitability is vulnerable to both rental income and the rental occupancy rate. These correlate positively with each other, i.e. a rise in the rental occupancy rate also means higher rental income, and vice versa. In areas suffering from depopulation, there is a scarcity of tenants regardless of the rental price level. Even the regional economic impact of thriving urban centres extends to a maximum radius of 15-20 kilometres into the surrounding areas. Owing to its good rail connections, only the Helsinki Metropolitan Area has a more extensive impact area (Aro, 2017). A building must therefore be located close enough to a thriving centre to be attractive and retain tenants after renovation.

Prudent housing investors concentrate their investments on the most productive or risk-free areas. This strategy is likely to increase the gap between housing quality levels in different areas. The quality of residential buildings in areas with weak demographic trends is declining, while more is being invested in housing quality in attractive areas. This phenomenon has been evident since the early 2000s (Vainio *et al.*, 2002).

So should the public sector compensate for interregional disparities? This has been tested on a large scale in Germany, where significant sums have been invested in the building stock in eastern areas. However, some renovated buildings have had to be demolished owing to a shortage of residents. Public funding should only be granted for buildings likely to be used until at least the end of the repayment period. Under no circumstances should it be granted for rental housing in areas where demand is dependent on a single economic activity as there would be a high risk of empty residences if the activity ceased.

Building regulations aim to establish a long lifecycle in all regions. Demographic changes and structural transformations in the economy suggest that temporary or relocatable homes

would be more sustainable in certain areas. Regardless of population loss, new buildings may be needed in order to provide the elderly with safe and accessible residences, for example.

The results are generalizable for areas with a functioning housing market. Demographic trends affect the renovation and volume of housing in an area, despite the greater effect of structural change within housing communities owing to the shrinking of housing communities by factors such as divorce and ageing (Vainio, 2016).

Decarbonatization of the existing building stock is urgent and challenging theme for research. At the growth centres there will be financing for this development. The big challenge is to finance decarbonatization areas with weak demographic trends.

Further studies should also focus on monetary value of the building. Owner or investor will know the monetary influence of the decarbonatization renovation work in three different population growth areas.

6. Conclusions

Examining the same case, but in different regions, demonstrates how vulnerable the viability of renovation and demolition-and-new-construction is to investment-based factors. We cannot therefore recommend a common housing strategy – decisions must be made project-specifically, in light of future use. The decision-making process must also take account of building-specific characteristics.

Owner-occupiers should not assume that renovation investments would increase the residence's sale price. In areas particularly affected by population loss, decisions should be taken solely from the perspective of one's own use, because it may not be possible to find subsequent occupants.

Retaining old buildings, and renovation to make them energy efficient, is not an end in itself; it is only justified if the buildings will be used long into the future. Long-term internal migration has concentrated the Finnish population and its natural growth in cities. The downside of this is the decline and ageing of the population in other parts of Finland. The same phenomenon is familiar in many other countries. Residential buildings lack, and will continue to lack, permanent residents. Heating an empty building constitutes the greatest energy waste of all. It is also wasteful to invest in the energy efficiency of buildings that will become empty in the near future. The calculated energy saving potential of the old building stock is unlikely to materialise.

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