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Conversion Meter; A new tool to assess the conversion potential of vacant office buildings into housing

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ABSTRACT: Building owners and other stakeholders can adopt different strategies to cope with vacancy, such as consolidation, rent reduction, selling the building, renovation, transformation and conversion to adapted reuse, or demolish and build a new building. This paper discusses a new developed tool to cope with vacancy by adaptive reuse. It presents an overview of the many factors and aspects that enable or hinder adaptive reuse by conversion of (office) buildings into housing, and how to assess the characteristics of the market, location, building and involved stakeholders. It presents the Conversion Meter, formerly known as the Transformation Meter, a tool to assess the conversion potential of vacant office buildings into housing.

KEYWORDS: Adaptive reuse, transformation, conversion meter, assessment tool, vacant buildings, risks, opportunities

1 INTRODUCTION: WHY ADAPTIVE REUSE?

Property owners have various possible strategies for dealing with vacant office buildings: consolidation, rent reduction to retain current tenants or to attract new tenants, selling the building, renovation or upgrading, demolition and new-build, and conversion to new functions (Remøy & Van der Voordt, 2014). Most owners choose consolidation i.e. keep the building as it is, search for new tenants and wait for better times. Mothballing a building or temporarily allowing use for anti-squat are usually not permanent solutions for coping with structural vacancy but may precede renovation, redevelopment and conversion. Demolition and new-build creates possibilities for a good fit with current and future users' needs. However, redevelopment takes time and causes interruptions to income streams. If the building is technically in a good state, redevelopment is a waste of resources and conflicts with global aims for sustainable development. If the building has a particular cultural or historical value or adds value to the identity of the location or a wider area, demolishment is not an appropriate strategy either. Conversion to new use may be a more appropriate approach.

So, an important question is: which factors may enable successful conversion to other functions, which factors are hindering adaptive reuse, what are the main opportunities and risks, and how can these risks be reduced or eliminated? Paragraph 2 presents an assessment tool to assess the opportunities and risks of conversion of office buildings to housing: the Conversion Potential Meter, abbreviated as the Conversion Meter. This part includes some important opportunities and risks found in Dutch cases. Finally, Paragraph 3 presents concluding remarks and recommendations.

1.1 *Market potential*

Adaptive reuse is an option to cope with vacancy in case of an oversupply of vacant buildings i.e. the level and duration of vacancy are high, and are expected to be high in the future as well, a sufficient demand for new functions and the costs and finance possibilities of adaptive reuse i.e. the return on investment is sufficient to stimulate property owners or other parties to invest in buying a vacant building and convert it to a new function.

The longer a building has been vacant, the more likely it is that continuation of its current function is not viable and adaptive reuse may be a more successful strategy. A vacancy level of 4-5% is perceived as necessary to enable companies to move. During the movement of the end user to another building the current building will be vacant for a while, the so-called 'frictional' vacancy. However, when too many buildings are structurally vacant i.e. are vacant for over three years this is an indication of a serious quantitative and/or qualitative misfit between demand and supply. Figure 1 shows the vacancy rate of office buildings in the Netherlands in the past twenty years.

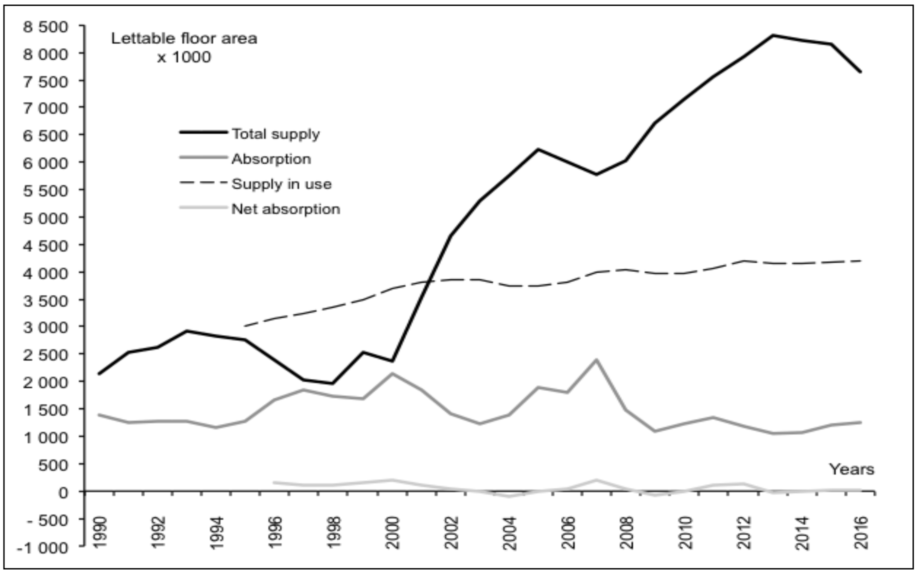

Figure 1. Vacancy levels in the Netherlands, 1995-2016 (Source: Soeter, J. and Remøy, H., 2016)

In order to be able to predict the vacancy risk of a particular building, Geraedts & Van der Voordt (2003) developed the so-called *vacancy-risk meter* to define the lower end of the office market. Factors that increase the risk of vacancy such as a poor location, insufficient parking facilities, limited accessibility by car or public transport or a poor technical condition plea for an intervention. Moreover, the same factors may hinder adaptive reuse because costly improvements will be necessary.

1.2 *Demand for new functions*

Without sufficient demand for other functions adaptive reuse will not be successful. So, it is important to assess the demand for space of prospective target groups and their needs and preferences. Table 1 shows a number of relevant characteristics of the location and the building that should be taken into account in case of conversions of vacant buildings into housing. On a more detailed level, it is relevant to make a distinction between sub-groups such as students, starters, young families, young urban professionals, and elderly people. These sub-groups have different demands regarding costs and quality, due to the different phases in life and different income levels that affect the affordable rent level or purchase price. In cities with many students and other young people conversion into low-cost accommodation may be a good choice.

In case of high-rise office buildings, conversion into accommodation for seniors and families can be noticed as an increasing (international) development in large cities. Market research to define the particular demand for dwellings may help to define which conversion is most appropriate to meet the needs and preferences of potential target groups.

Table 1: Relevant aspects on the demand side of residential accommodation

Location (housing environment)	Building (residential)	
1. Atmosphere	1. Dwelling type	9. General conditions
a. Nature of built environment	2. Access	a. Accessibility
b. Social image	3. Dwelling size	b. Safety
c. Liveliness	a. Number of rooms	c. Flexibility
d. Available green space	b. Living room	d. Adequate management
2. Facilities	c. Kitchen	10. Costs
a. Shops	d. Bedrooms	a. Purchase price/rent
b. Restaurants, bars, etc.	e. Sanitary facilities	b. Other costs
c. Schools	f. Storage space	
d. Bank/Post office	4. Arrangement of dwelling	
e. Medical facilities	5. Level of facilities	
f. Recreative facilities	6. Outside space (garden, etc.)	
3. Accessibility public transport	7. View from dwelling, privacy	
a. Distance to bus stop	8. Environmental aspects	
b. Frequency and times	a. Heating	
c. Distance to tram/underground	b. Ventilation	
4. Accessibility by car	c. Noise	
a. Distance to motorway	d. Exposure to sun/daylight	
b. Congestion level	e. Energy consumption	
c. Parking facilities	f. Materials used	

1.3 *Location potential: opportunities and risks*

Adaptive reuse requires that the location fits with the requirements of the new target group i.e. prospective new users and owners. Worldwide, properties in city centres, housing areas or edges of such areas are converted into housing, while conversion of buildings in business parks and peripheral areas rarely happen. Building conversions in city centres can offer valuable additions to the existing housing stock. Considering the functionally realisable apartment types as well as the location of office buildings, interesting target groups (buyers or renters) can be found. Office buildings in mono-functional business parks however, are not regarded fit for conversion into housing. When structurally vacant office buildings are situated in such locations, transformation of the area is necessary (Avidar et al., 2007, Smit, 2007, Koppels et al., 2011).

1.4 *Building characteristics: opportunities and risks*

The functional adaptability of vacant buildings is of critical importance to conversion feasibility. This depends inter alia on the measurements of the buildings' structural grid (Geraedts & Van der Voordt, 2007). For instance, post-war office buildings were designed as "cockpits" to fit closely around the function they were meant to accommodate. This tight fit threatens the functional feasibility of conversion into housing.

A high architectural or cultural-historical value and being marked as a monument will hinder demolition and stimulate adaptive reuse (Benraad & Remøy, 2007). Most office buildings are not listed though, as many are relatively new and not known for their interesting architecture (Remøy et al., 2009). In these cases, the main driver for conversion is not to protect the current building but to get it reused, in order to contribute to the quality of the environment and the future value of the location and the building itself. Requirements to keep and preserve a national or municipal monument can hinder adaptive reuse, for instance because balconies cannot be added to the façade.

Usually, building characteristics do not make conversion impossible, but they can influence financial feasibility substantially. When conversion costs become too high compared to the expected benefits, conversion may be financially unfeasible.

Mackay et.al. (2009) studied several Dutch conversion projects and found an evident relationship between building costs and the alterations of specific building elements. The major cost generator for most office-to-housing conversions is facade-alteration (27% of the total building costs), followed by interior walls (17% of total building costs) and contractor costs, a group of costs in Dutch estimates combining site costs, general costs of the contractor and his profit (15% of total building costs). Whereas the costs for interior walls depend on the new function and can easily be predicted, the costs related to the facade depend on the building shape, technical state and quality of the existing building, and on the demand for external appearance, comfort and quality of the converted building. The necessity for facade alterations should therefore be thoroughly assessed when studying office-to-housing conversion potential.

2 CONVERSION METER

To assess the opportunities and risks of conversion of vacant office buildings to dwellings and to define its conversion potential in a systematic, efficient way, the factors and aspects mentioned above have been integrated in a Conversion Potential Assessment Tool, in short: Conversion Meter, formerly known as the Transformation Meter (Geraedts & Van der Voordt, 2002, Geraedts & Van der Voordt, 2007). Methods to develop this tool included a literature review, interviews with experts such as developers and housing associations with practical experience in converting office buildings to housing, and case studies to test preliminary versions of the tool.

The first version, Transformation Meter 1.0, was developed during the late 1990s, when the Netherlands suffered from high levels of office vacancy. Since then, many graduation students from the Faculty of Architecture at the Delft University of Technology and students from other universities as well have conducted case studies to test and evaluate the tool. These practical applications allowed us to further improve and refine the transformation potential meter (Geraedts & Van der Voordt, 2014). Two new steps - the financial feasibility scan and the risk assessment checklist – have been added to permit further investigation of the feasibility of a conversion project. In this paragraph, we describe the principle of the new transformation meter and its position in the Go/No Go decision-making process in the initial phase of a conversion project: the Conversion Meter.

2.1 *The Conversion Meter at a glance*

In essence, this instrument consists of several checklists be used to appraise the potential of vacant buildings for conversion to residential use. This appraisal takes place in a number of steps, from more superficial to more detailed and specific, see Table 2: Overview of steps to be taken).

Table 2: Conversion Meter Process

Step	Action	Level	Outcome
Step 0	Inventory market supply of unoccupied offices	Stock	Location of unoccupied offices
Step 1	Quick Scan: initial appraisal of unoccupied offices using veto criteria	Location Building	Selection or rejection of offices for further study; Go / No Go decision
Step 2	Feasibility scan: further appraisal using gradual criteria	Location Building	Judgement about transformation potential of office building
Step 3	Determination of transformation class	Location Building	Indicates transformation potential on 5-point scale from excellent to not transformable
Further analysis (optional, and may be performed in reverse order if so desired):			
Step 4	Financial feasibility scan using design	Building	Indicates financial/economic feasibility Sketch and cost-benefit analysis; Go / No Go decision
Step 5	Risk assessment checklist	Location Building	Highlights areas of concern in transformation plan; Go / No Go decision

2.2 *Step 0: Inventory of supply at city, district or portfolio level*

As a pre-step before actually starting to use the Conversion Potential Assessment Tool, an inventory may be needed of the market supply of office buildings in a particular municipality, area or portfolio that have been unoccupied for a long time or may be expected to become vacant in the near future. Information may be obtained from a literature survey, data from real estate agents or the investigator's own observations.

2.3 *Step 1: Quick Scan; first impression, evaluation based on veto criteria*

The instrument offers the user the possibility to perform a quick initial appraisal of the conversion potential, which is not very labour-intensive and does not require much data. This quick scan makes use of six veto criteria under the headings Market, Stakeholders, Location and Building, see Table 3.

Table 3: Step 1 Quick scan with veto criteria

STEP 1 QUICK SCAN: initial appraisal of unoccupied offices using veto criteria

Common target group independent criteria.
*Answer '**Yes**' (score = 1) is positive for conversion into homes. Answer '**No**' (score = 0) is negative for conversion into homes*
The user of this checklist could reconsider if these criteria actually lead to a veto decision.
If one of the veto criteria concerned lead to the assessment 'No', the conversion into housing is cancelled.
In that case the next step 2 (Feasibility scan: further appraisal using gradual criteria) is no longer applicable.

ASPECT	VETO CRITERION	DATA SOURCE	Assessment Yes	Assessment No
VETO CRITERIA MARKET				
1 Demand for housing	1 There is a demand for housing of local target groups	Estate agent or municipality		
VETO CRITERIA STAKEHOLDERS				
2 Initiator (advisor)	2 Presence of enthusiastic influential instigator	Local investigation		
3 Developer	3 Does meet criteria for region, location, accessibility	Property developer		
	4 Does meet criteria on size and character of building	Property developer		
4 Owner	5 Willingness to sell the building	Owner		
5 Investor	6 Willingness to buy and transform the building	Investor		
6 Municipality	7 Positive attitude of the municipality	Municipality		
VETO CRITERIA LOCATION				
7 Urban location	8 Zoning plan permits modification	Zoning plan, policy of municipality		
	9 No serious public health risk (pollution, noise, odour)	Estate agent or on site inspection		
VETO CRITERIA BUILDING				
8 Dimensions of skeleton	10 Free ceiling height > 2.60	Estate agent or on site inspection		
		RESULT QUICK SCAN:	0	0

A veto criterion is a criterion that if not satisfied (if the answer to the relevant question is 'No') leads to rejection of the option to convert the building into residential accommodation. Further detailed study is then no longer necessary. This is thus an effective means of selecting promising candidates for conversion quickly from the real estate market.

Table 4: Step 2 Feasibility scan using gradual criteria at location level; answer 'Yes' (score = 1) is positive and answer 'No' (score = 0) is negative for conversion into homes

STEP 2 FEASIBILITY SCAN: further appraisal using gradual criteria

*Answer '**Yes**' (score = 1) is positive for conversion to homes. Answer '**No**' (score = 0) is negative for conversion into homes*
The user of this checklist could reconsider if on of these these criteria actually has to be a veto criterion.
If so, then this criterion switches to Step 1 and the other way around.

LOCATION

ASPECT	GRADUAL CRITERION	DATA SOURCE	Assessment Yes	Assessment No
FUNCTIONAL				
1 Urban location	1 Building in suitable area (not remote industrial or offices area)	Town map / Google Maps		
	2 Good daylight/sunlight possibilities	On-site inspection		
	3 Good view from building, > 75% floor space	On-site inspection		
2 Distance and quality of facilities	4 Shop for daily necessities < 500 m.	Local investigation / Google Maps		
Remark:	5 Neighbourhood meeting-places (square, park) < 500 m.	Local investigation / Google Maps		
The quality of facilities can be described in terms	6 Food service industry (bar, café, restaurant) < 500 m.	Local investigation / Google Maps		
of quality, a wide variety and the number of	7 Bank / post office < 5 km.	Local investigation / Google Maps		
different facilities	8 Basic medical facilities (practice, health centre) < 2 km.	Local investigation / Google Maps		
	9 Sports facilities (fitness, swimming pool, sports park) < 2 km.	Local investigation / Google Maps		
	10 Educational facilities (from kindergarten to university) < 2 km.	Local investigation / Google Maps		
3 Accessibility by public transport	11 Distance to railway station < 2 km.	Town map / Google Maps		
	12 Distance to bus, tram, underground < 1 km.	Town map / Transport services		
4 Accessibility by car and parking facilities	13 Good flow, normal street quality	Local investigation / Google Maps		
Obstacles: bottlenecks or thresholds in roads, bridges	14 Distance to parking sites < 250 m.	Local investigation / Re-design		
Flow: 1-way traffic, no parking, traffic jam	15 > 1 parking lot/100 m2 office space	Local investigation / Re-design		
CULTURAL				
5 Representative impression	16 Situated centrally (not near highway locations)	Town map / Google Maps		
Remark:	17 Other buildings present in direct neighbourhood	Town map / Google Maps		
Assessment of location dependent of target group	18 Lively neighbourhood	On-site inspection / local press		
E.g. Youngsters not in mono-functional area	19 Direct availability of green environment	Local investigation / Google Maps		
E.g. 55+ not outside city centre	20 Area has a good reputation/image; no vandalism	On-site inspection / local press		
Related to impression of building	21 Area has good air quality and low pollution and noise hindrance	On-site inspection / local press		
LEGAL				
6 Urban location	22 Noise load on façade < 50 dB (e.g. max. for office building is 60 dB)	Municipal authorities		
7 Ownership of location	23 Land in property or with short lease	Estate agent / municipality		
		Total Location (=number Yes):	0	x
		Default weighting:	5	=
Maximum score for Location (with default weighting 5) = 23 x 5 = 115		Maximum Score Location:	115	
		FEASIBILITY SCAN LOCATION:	0	A

2.4 *Step 2: Feasibility scan based on gradual criteria*

If the results of the Quick Scan indicate that there is no immediate objection to conversion (no single question is answered 'No), the feasibility of conversion can be studied in greater detail by assessing a number of 'gradual' criteria, i.e. criteria that do not lead to a GO/NO GO decision but express the conversion potential of the building and its location in a numerical score. The feasibility scan at location level (Table 4) includes 7 main criteria. The feasibility scan at building level (Table 5) comprises 14 main criteria. An answer 'Yes' to any question indicates somewhat higher suitability for conversion. At the end of the scan, the number of 'Yes's' is added up to obtain the overall conversion potential score – the higher the better. It may be noted that the criteria vary somewhat, depending on the target group considered. For example, students will prefer to live in the city centre where there is more nightlife, while young families with children will tend to opt for a peaceful suburban environment.

Table 5: Step 2 Feasibility scan using gradual criteria at building level. Answer 'Yes' (score = 1) is positive and answer 'No' (score = 0) is negative for conversion into homes

STEP 2 FEASIBILITY SCAN: further appraisal using gradual criteria

*Answer '**Yes**' (score = 1) is positive for conversion to homes. Answer '**No**' (score = 0) is negative for conversion into homes*
The user of this checklist could reconsider if on of these these criteria actually has to be a veto criterion.
If so, then this criterion switches to Step 1 and the other way around.

BUILDING

ASPECT	GRADUAL CRITERION	DATA SOURCE	Assessment Yes	Assessment No
FUNCTIONAL				
1 Year of construction or renovation	1 Building > 3 years	Year of construction		
	2 Building renovated > 3 years	Year of last renovation		
2 Vacancy	3 Complete building is vacant	Estate agent		
	4 Building vacant > 3 years	Estate agent		
3 New housing	5 Capacity building > 20 1p-units / 50 m2	≥ 1000 m2 floor space		
	6 Lay-outs adaptable for local target groups	Sketch design		
4 Extendibility	7 Horizontal extension building possible (neighbouring buildings)	On-site inspection / Google Maps		
	8 Vertical extension building possible (no inclined roof/light construction)	On-site inspection / estate agent		
	9 Possibilities for constructing basement	On-site inspection / estate agent		
CULTURAL				
5 Representative impression	10 Identifiable compared to surrounding buildings	On-site inspection		
Related to impression of location	11 Own identity realisable	On-site inspection / re-design		
6 Cultural heritage	12 Being not a cultural heritage: simplifies transformation	Municipality / Authorities		
7 Access (entrance, elevators, stairs)	13 Clear, safe and clarifying building entrance	On-site inspection / re-design		
TECHNICAL				
8 Condition of maintenance	14 Well maintained; maintenace up-to-date	On-site inspection / facades		
9 Dimensions of support structure	15 Depth of building < 10 m.	On-site inspection / estate agent		
E.g. Facade grid size determines location inner walls	16 Grid support structure > 3.60 m	On-site inspection / estate agent		
	17 Height dimension between floors < 6.00 m	On-site inspection / estate agent		
10 Support structure (walls, columns, floors)	18 Condition support structure is good / not hazardous	On-site inspection / estate agent		
11 Facade	19 Possible connection inner walls on grid < 5.40 m.	On-site inspection / estate agent		
External living space dependant of target group	20 Facade/openings well adaptable	On-site inspection		
Cultural heritage: limited / no adaptability	21 Facade windows can be reused / opened	On-site inspection / re-design		
12 Installations	22 Sufficient service ducts can be constructed	On-site inspection / re-design		
LEGAL				
13 Environment	23 Absence of large amount of hazardous materials in building	On-site inspection / municipality		
Exposure to sunlight, air, noise pollution,	24 Acoustic insulation of floors > 5 dB	On-site inspection / re-design		
hazardous materials	25 Good thermal insulation of facades and roof	On-site inspection / municipality		
	26 Sufficient daylight factor > 90% floor surface new units	On-site inspection		
14 National Building Decree, escape and access routes	27 Elevators available / easy realisable in building (> 4 stories)	On-site inspection / estate agent		
	28 (Emergency) stairways available / realisable	On-site inspection / re-design		
	29 Distance of new units to stairs/elevators < 50 m.	On-site inspection / re-design		
		Total Building (=number Yes):	0	x
		Default weighting:	3	=
Maximum score for Building (with default weighting 3) = 29 x 3 = 87		Maximum Score Building:	87	
		FEASIBILITY SCAN BUILDING	**0**	**B**

2.5 *Step 3: Determination of the conversion potential class*

The results of the feasibility scan can be used to calculate a conversion potential score, based on which the building can be assigned to one out of five conversion classes ranging from 'No Transformation potential' till 'Excellent Transformation Potential', see Table 6.

Table 6: Step 3 Determination of conversion potential class of office building

STEP 3: DETERMINATION CONVERSION POTENTIAL CLASS OF OFFICE BUILDING

CONVERSION SCORE	CONVERSION CLASS		
Conversion Score Location + Building = 0 - 40	Class 1: No transformation potential	**Total Score Feasibility Scan A + B:**	**0**
Conversion Score Location + Building = 41 - 80	Class 2: Hardly any transformation potential	Maximum Score Location + Building	
Conversion Score Location + Building = 81 - 120	Class 3: Limited transformation potential	← = 115 + 87 =	202
Conversion Score Location + Building = 121 - 160	Class 4: High transformation potential		
Conversion Score Location + Building = 161 - 202	Class 5: Excellent transformation potential	→ **CONVERSION CLASS**	**1**

The total scores for the location (result 'A' in Table 4) and the building (result 'B' in Table 5) are determined by multiplying the number of Yes's in the respective tables by a weighting factor, which has provisionally been chosen as 5 for the location and 3 for the building to reflect the greater relative importance of the location in these considerations. The maximum possible score for the location is thus 23 x 5 = 115, and for the building 298 x 3 = 87, summing up to a grand total of 115 + 87 = 202 (see Table 6). The minimum score is zero, which would indicate that no single feature of the location or the building is considered suitable for conversion.

Buildings in Conversion Class 1 (scoring lower than 40) are assessed as not suitable for conversion to residential accommodation, while those in Class 5 (scoring higher than 161) are perceived as excellently suitable for conversion. In the examples of Table 3 and Table 4 no assessment scores for Location and Building have been filled out yet, and as such the total scores in Table 6 is '0', corresponding with Conversion class 1: No transformation potential.

The total score is an indication of the conversion potential but does not define the final decision. In practice, some criteria can be more dominant than others. Decision-makers are free to adapt the default weight values of 3 (building) and 5 (location) if that fits better with the particular context.

Determination of the conversion class of an office building completes the first three steps of the Conversion Potential Assessment Tool. If the results indicate that the building has sufficient potential for conversion (i.e. that it falls into Conversion Class 4 or 5), the analysis can be continued by two additional steps, aimed at studying the financial feasibility of the conversion project (Step 4) and conducting a risk assessment for further planning (Step 5). Depending on the nature of the project involved, step 5 may come before step 4. The Conversion Potential Assessment Tool is particularly intended for use in the initial phase of the plan development process, from a first quick scan to a well-based decision about whether or not to proceed with the project.

2.6 *Step 4: Financial feasibility scan*

The financial feasibility scan aims to obtain an indication of the viability of a conversion project. It is not meant yet as a detailed calculation based on the costs of all construction elements, materials, labour costs etc. The financial feasibility depends among other things on the acquisition costs, the current condition of the building, the level of renovation or modification work required, the finishing and comfort level of the housing, the number of (extra) dwelling units that can be created in the building and the project yield by rental income and/or sales prices. On the revenue side, key-figures are the number of dwellings that can be created for the intended target groups, and the rent level or purchase price these target groups might be willing to pay. A sketch plan of a possible layout of the building after conversion is useful to get an indication of the number and types of dwellings that can be incorporated in the current building.

The financial feasibility can be improved by increasing the size of the building, e.g. by adding extra floors on top, by a horizontal extension, or by the inclusion of commercial functions (usually at ground level). On the expenses side, it is necessary to know the acquisition costs for the premises, including the land price, and the conversion costs i.e. the building and installation costs. Relevant questions to be asked are for instance: what is the current condition of the building? Which parts can be reused, and which will have to be demolished? What is the ratio of façade surface area to gross floor area (GFA)? To what level should the building be finished? To what extent can the existing stairways, lifts and other means of access and façade proportions be maintained?

Table 7 shows some key conversion and purchase cost figures that determine the total investments costs, based on 12 cases of the Stadswonen Housing Association in Rotterdam, the Netherlands. The data originate from 2002 and have been updated till 2016 by P. de Jong, Delft University of technology (February 2017). A distinction has been made between conversion projects with a low or a high level of interventions. All figures are in Euro's/m2 gross floor area (GFA), including VAT.

The cost differences between the most expensive and least expensive projects showed to be determined to a large degree by the costs of (conversion of) the façade.

The inner walls are on average more expensive, but these costs are less variable and thus have less influence on the overall level of the structural costs. The current supporting structure also has a significant influence on the total costs.

Table 7: Indication of conversion and purchase costs based on 12 cases from the Netherlands

Dwelling types and Residents	Low level of interventions		High level of interventions	
	Construction costs	Purchase costs	Construction costs	Purchase costs
Student room	460 - 620	230 - 310	550 - 740	140 - 190
Studio	620 - 930	310 - 460	740 - 1110	190 - 270
2/3-room apartment, young couples	770 - 1030	380 - 520	930 - 1230	190 - 260
4-room apartment, young couples	770 - 1150	380 - 570	930 - 1380	270 - 400
3-room apartment, senior citizens	370 - 560	180 - 270	450 - 660	110 - 170
4/5-room apartment, senior citizens	500 - 1150	250 - 570	600 - 1380	140 - 340

Table 8 shows an overview of monthly rental income and residual investment budgets per unit and per m2 rental floor area (RFA) or m2 gross floor area (GFA), in connection to different dwelling types and target groups (Vrij de, 2002). The data are based on the same 12 cases as in Table 7 and also have been updated by P. de Jong, TUD, February 2017. The ratio between GFA/RFA varied the case studies from 1.3 - 1.55. The target groups define the required type of home, the number and layout of the rooms, access, appeal and the size of the outdoor area. Using this data, floor plans can be drawn and fitted in the existing building. When drawing floor plans, existing stairs, lifts, access paths, design lines and façade boundaries must be respected. Based on the layout of the homes, the number of homes can be estimated and an indication of the rental price or selling price can be established.

Table 8: Feasible rental income and investments per unit, per m2 rental floor area (RFA) and per m2 gross floor area (GFA); the assumed ratio between both floor areas: GFA/RFA = 1.3 - 1.55

Dwelling types and Residents	Rent/month of dwellings	Feasible investment per unit	Feasible investment per m2/RFA	Feasible investment per m2/GFA
Student room	176 - 242	35.580 - 53.370	1.100 - 1.460	770 - 1.010
Studio	242 - 352	53.370 - 77.090	1.460 - 2.170	1.010 - 1.540
2/3-room apartment, young couples	605 - 825	130.460 - 177.900	1.920 - 2.300	1.300 - 1.720
4-room apartment, young couples	825 - 1100	177.900 - 237.200	1.920 - 2.5.50	1.300 - 1.900
3-room apartment, senior citizens	440	88.950	940 - 1.200	590 - 950
4/5-room apartment, senior citizens	605 - 1210	130.460 - 260.920	1.300 - 2.550	830 - 1.900

The ratio between rental floor area (RFA) and gross floor area (GFA) explains how much floor area is used for construction, facilities and circulation areas. The higher this ratio is, the better the space utilisation of the building. A project with less efficient floor plans is usually less financially feasible. Small homes are often easier to fit in existing buildings, which increases the efficiency. For tower blocks, the division into dwellings is less efficient than for elongated buildings. In the tables above an efficiency ratio of gross floor area (GFA)/rental floor area (RFA) between 1.3 and 1.55 is assumed. Other key data are the shape of the layout and the relationship between open and closed parts of the façade. The floor layout could influence the façade surface. Square layouts have less façade surface than elongated floor plans. The amount of open and closed parts of the facades influences the financial feasibility because closed parts usually are cheaper.

2.6.1 *Future value: adaptability*

The adaptive capacity of buildings may have a large impact on the future value of buildings. Today's methods for determining the financial feasibility of building conversions do not normally consider this future value sufficiently. The adaptive capacity of a building can only be valued in the use phase of the building when functional and structural adaptions are required. To make buildings that are adaptable in the future usually requires extra initial construction costs.

When only taking into account the initial construction costs, an adaptable building is less attractive than a 'non-adaptable' building (Hermans, 2014). Therefore, not only investment costs should be taken into account but also the total lifecycle costs. The longer a building is kept in its function instead of becoming vacant or being demolished, the more sustainable that building will be. The adaptive capacity of a building includes all characteristics that enable the building to keep its functionality through changing requirements and circumstances, during its entire technical lifespan and in a sustainable and financially profitable way. The adaptive capacity is considered a crucial component when looking into the sustainability of the real estate stock (Geraedts, 2016).

2.7 *Step 5: Risk assessment checklist with possible solutions*

When the Quick Scan indicates that an office building has sufficient conversion potential at both the location and the building level and the results of the initial financial feasibility analysis are also encouraging, the involved actors may proceed to the subsequent development phases. It is of great importance to be aware of the possible bottlenecks and risks that may come to the fore.

Table 9 presents a risk assessment list with possible solutions at Market and Location level, including the point of view from some important stakeholders. Table 10 presents a risk assessment list with possible solutions at building level. Neither of these lists is exhaustive. Both checklists list the possible risks under the same headings as those used in the quick scan and feasibility scan i.e. from a functional, cultural, technical, legal and financial point of view.

Table 9: Risk assessment checklist, possible solutions and important stakeholders

MARKET & LOCATION		RISC	POSSIBLE SOLUTION
1. Functional	1	Insufficient parking places	Dependant of target group; consultation about parking rules; consider parking basement
	2	Lack of facilities	Low scale facilities in building; collaboration with other stakeholders
	3	Absence public transport	Consulting public transport companies; collaboration with other stakeholders
	4	Unclear routing to building	Analysis neighbourhood; replacement main entrance or adding extra entrance
2. Cultural	5	Bad reputation or unsafe neighbourhood	Improvement neighbourhood in collaboration with other stakeholders; choice for specific target group
3. Technical	6	Annoyance of odour	Specific insulation of facades concerning
	7	Annoyance of noice	Possibilities for dispensation; extra noise insulation facades; extra membrane façade
4. Legal	8	Zoning plan change/procedure	Consulting local authorities; assessment of local policy and regulations
	9	Ground posession/lease	Unfavourable for development ground value; trying to reimburse ground lease
	10	Ground pollution	Clear ground declaration by owner; negotiating lower ground selling price due to cleaning ground costs
	11	Restriction maximum building height	Research for possibilities horizontal extension possibilities
5. Financial	12	Purchasing price dwellings to high	Extra benefits trough combination with commercial functions; redesign plot; other target group
	13	Bad lettability of dwellings	Improvement price/quality ratio; choice for other target groups
	14	Necessity of other, new facilities	Enhance financial feasibility by adding commercial functions
STAKEHOLDERS			
1. Initiator	15	Absence of enthusiastic influential initiator	Search for experienced instigator at other successfull locations, realised projects
2. Developer	16	Does not meet criteria for region, location, accessibility	Consulting and convincing property developer; search for other property developer
	17	Does not meet criteria on size and character of building	Consulting and convincing property developer; search for other property developer
3. Owner/investor	18	Not willing to sell the building	Consulting and convincing owner on realistic costs and benefits of building staying vacant

Table 10: Risk assessment checklist with possible solutions at Building level

BUILDING		RISC	POSSIBLE SOLUTION
1. Functional	1	False presuppostion with possibilities building	Analysis form factors, key rations, data; gross/nett floor area; extension possibilities (horizontal/vertical)
	2	Building depth to small	Adaptation layouts; enlanrgement depth by new foundation/facades; adding external gallery
	3	Building depth to large	Adaptation layouts; adding new open inner space (daylight) centralise entrances
	4	No basement available (f.i. for parking places, storage space)	Adding basement (dependant of foundation and access possibilities)
	5	Floor height to large	Use of lightweight mezzanines, combined with lightweight interior walls
	6	Windows can not be opened	Replacement windows; façade renovation
	7	Less connection possibilities for inner walls at facades	Connectable inner walls till complete façade renovation
	8	Lack of outdoor space	Target group dependant; French balconies; recessed parts façade; inner garden
	9	Insufficient elevators/stair cases (access and escape routes)	New elevators/stair cases within or extern building
	10	Insufficient access possibilities	Analysis different access possibilities (portico, gallery, inner corridor, central)
	11	Qualititive/quantitative insufficient existing inner walls	Adapt existing walls; adding new walls (future adaptability)
	12	Insufficient waterproofness for bathrooms	Waterproof finishing floors; use of prefab (plastic) bathrooms
2. Cultural	13	Limitations by monumental status	Early consulting with monumental agency and local government
	14	Insufficient distinguishability of building	Adding new façade (parts), balconies, dwelling entrances
	15	Insufficient distinguishability of building entrance	Emphasise by louver or something likewise; replacement to other location
3. Technical	16	False presuppostion with (quality of) construction status	Analysis construction status on site (design, condition, finishing, maintenance)
	17	Insufficient air climat facilities	Replacement/renewal adjusted to dwellings; individual md op woningen; individueel operated
	18	Insufficient piping, tubes and shafts	Extension (fire resistant walls between dwellings; holes in existing floors)
	19	Insufficient water supply facilities (f.i. need dwellings > offices)	Extension facilities (individual controlable and measurable)
	20	Insufficient electricity facilities	Extension facilities (individual controlable, measurable)
	21	Insufficient noise insulation of floors	Enhance floor insulation by double floors and/or double ceilings
	22	Insufficient thermal insulation of facades	Extra insulation outside or inside façade (monumental status); mind adapting windows
	23	Insufficient thermal insulation of windows	Replacement by double glazing; extra secundairy frame; extra membrane façade Inside or outside)
	24	Insufficient thermal insulation of facades of roof	Insulation existing roof (inside/outside); replacement by new roof; combine with vertical extension
	25	Presence of moisure, humidity	Analysis causes; humidity, leakage, condensation
	26	Bad flushing in facades	Cleaning façade; new flushing (partly of total)
	27	Insufficient daylight and sunlight (< 10% floor surface)	Implement inner corridors, extra holes in floors, bay windows, new large windows; ask for dispensation
	28	Bad/dangerous support structure	Reconstruction; extra reinforcement, steel, gunned concrete, assistant construction; fire resistance
	29	Limited carrying capacity or bad foundation	Reconstruction (extra piles, foundation)
	30	Insufficient carrying capacity for vertical building extensions	Implementation of lightweight construction (steel or timber frame) for new floor levels
4. Legal	31	Presence of asbestos; costly removal by requirements	Negociation lower selling price, demanding asbestos free declaration by seller of building
	32	Restrictions possibilities by (local) regulations	Dispensations: outer space, ceiling height, entrance/access, daylight, insulation
	33	Uncertainty/vagueness about building permittance	Early local communication about demands and information to be delivered
	34	Insufficent imbedding fire safety requirements	Early local communication about (access, fire escape routes, etc.)
5. Financial	35	Building difficult to buy/acquire	Step by step purchase; at first ground lease, in a later stage poseesion; collective purchase with other stakeholders
	36	Large investment in initial phase (advisors,feasibility study)	Financial feasibility study
	37	Difficult feasibility (f.i. building is too small)	Analysis of extension possibilities; combinations with other (commercial) stakeholders; search for subidies
	38	Risk of vacancy; impoverishment (f.i. long lasting development)	Limitation of vacancy period through temporary let of (parts of) building

2.8 *Example of risk at location level: noise pollution*

Risk: Excessive noise level at façade. According to the Dutch Noise Pollution Act, this value should not exceed 60 dB for offices and 50 dB for dwellings. Similar levels are used internationally.

Solution: Many inner-city locations are situated near major roads, railways or industrial premises. If the properties are rezoned for residential use, they will have to meet much more stringent requirements and quite extensive measures may be needed to ensure compliance. Exemption may sometimes be granted for residential property situated near major roads or railways, i.e. the maximum permitted noise level at the façade may be raised in such cases, but extra measures will still have to be taken to keep the sound level within the building at acceptable levels. Some of these measures will involve modification of the building, but noise screens placed round the source of the noise may also be effective. Another option is to locate rooms where less stringent noise standards apply, such as workshops or bathrooms, where the noise load is highest.

2.9 *Example of risk at building level: poor financial feasibility*

Risk: a (too) high acquisition price of the office building, renovation costs that are higher than expected, or a small size of the building so that all costs have to be paid back by a limited number of tenants.

Solution: In case of conversion of office buildings to residential accommodation, in general the larger the complex to be converted, the easier it is to make the project financially feasible. The investments needed to make the existing building suitable for residential purposes can be partially financed by extending the size of the building, horizontally and/or vertically (by adding new storeys on top of the building). One advantage of adding new built premises is that the extra land costs are basically zero. If new floors are added, the building’s supporting structure must be strong enough to bear the extra load, or must be reinforced to this end. Horizontal extensions must fit in with the location and usually permits must be obtained from the municipal authorities (town planning, building control, fire safety). Another possible way of improving the financial feasibility is to rent out retail, business or office space on the ground floor or to rent out parking space. Currently exemptions from particular building regulations can be received, provided that that converted buildings should comply at least with the building regulations of the year when the original building was constructed.

3 CONCLUDING REMARKS

Although the Conversion Meter has been developed to assess the conversion potential of vacant office buildings and conversion to housing, many follow-up studies have shown that the underlying principles and criteria are applicable to other types of conversion well, with some minor adaptations.

The Conversion Potential Assessment Tool has been developed for use in a Dutch context. A next step is to examine its applicability and related data in other countries. Further testing of the new Conversion Meter in current Dutch cases is relevant too. Additional case studies in the Netherlands and in other countries will provide a better insight in the impact of national and local legislation and the economic and cultural context. The same counts for the financial feasibility scan (Step 4) and financial ratios.

The practical applicability of the Conversion Meter may be improved by digitising the tool and by adding photos, sketches and boxes with lessons from case studies to illustrate the criteria and risks checklist. Another topic is to explore the need for extra modules looking at particular issues such as sustainability. Finally, the criteria could be linked to tools for adaptable buildings in order to make future conversions functionally and technically more simple and less expensive. Buildings that support the possibilities of adaptive reuse are more ready to change and make it easier to cope with an ever-changing real estate market and as such will contribute to a more resilient built environment.

REFERENCES

Avidar, P., Havik, K., & Wigger, B. 2007. Gentrification: stromen en tegenstromen. Oase, 73, 9.

Benraad, K. & Remøy, H. 2007. Belevingswaarde. In: Van der Voordt, D.J.M., Geraedts, R.P., Remøy, H.T., Oudijk, C. (eds.) Transformatie van kantoorgebouwen thema's, actoren, instrumenten en projecten. Rotterdam: Uitgeverij 010.

Geraedts, R.P., Van der Voordt, D.J.M. 2002. Transforming Offices into Homes. CIB W104 Open Building Implementation, Balancing Resources and Quality in Housing. Mexico City: Mexican Institute of Architects, The Housing Institute of Mexico City, Universidad Autonoma Metropolitana (UAM); the Universidad Iberoamericana; Habitat International Coalition, and TAVI.

Geraedts, R.P., Van der Voordt, D.J.M. 2003. Good Buildings Drive out Bad Buildings; an instrument for defining the lower end of the office market; transformation into homes. In: Hong Kong, A. H. (ed.) CIB W104 Open Building Implementation, Dense Living Urban Structures. Hong Kong: HKU.

Geraedts, R.P., Van der Voordt, D.J.M. 2007. The New Transformation Meter; A new evaluation instrument for matching the market supply of vacant office buildings and the market demand for new homes. Building Stock Activation 2007. Tokyo.

Geraedts, R.P., Van der Voordt, D.J.M. 2014. Transformation Meter New; version 17-3-2014. In: DELFT, T. (ed.). Delft: Faculty of Architecture, Department of Real Estate & Housing.

Geraedts, R.P. 2016. Flex 4.0, a practical instrument to assess the adaptive capacity of buildings. Energy Procedia, 96, 2016, 12.

Hermans, M., Geraedts, R.P., Van Rijn, E., Remøy, H.T. 2014. Determination Method Adaptive Capacity of Building to Promote Flexible Building; Bepalingsmethode Adaptief Vermogen van gebouwen ter bevordering van flexibel bouwen. Leidschendam: Brink Groep.

Koppels, P.W., Remøy, H.T., & El Messlaki, S. The negative externalities of structurally vacant offices: An exploration of externalities in the built environment using hedonic price analysis. In: Jansen, I., ed. ERES 2011, 18th Annual European Real Estate Society Conference, June 15-18, 2011 Eindhoven.

Mackay, R., De Jong, P. & Remøy, H.T. Transformation building costs; understanding building costs by modelling. In: Wamelink, H., ed. Changing Roles, 2009 Rotterdam. Delft University of Technology.

Remøy, H.T., Koppels, P.W., De Jonge, H. 2009. Keeping up Appearance. *Real Estate Research Quarterly,* 8**,** 6.

Remøy, H.T., Van der Voordt, D.J.M. 2014. Adaptive reuse of office buildings: opportunities and risks of conversion into housing. Building Research & Information, 42, 9.

Smit, A.J. 2007. Transformatie van verouderde bedrijventerreinen. In: Van der Voordt, D.J.M., Geraedts, R.P., Remøy, H.T., Oudijk, C. (eds.) Transformatie van kantoorgebouwen thema's, actoren, instrumenten en projecten. Rotterdam: Uitgeverij 010.

Vrij de, N. 2002. Measuring is knowing. Delft: Delft University of Technology.