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Obsolescence – understanding the underlying processes

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Abstract

Obsolescence, defined as the process of declining performance of buildings, is a serious threat for the value, the usefulness and the life span of built properties. Thomsen and van der Flier (2011) developed a model in which obsolescence is categorised on the basis of two distinctions, i.e. between endogenous and exogenous cause-effect relationships and between physical and behavioural cause-effect relationships. In this way, the model presents a classification of underlying factors of obsolescence. However, these underlying factors, more specifically the underlying cause-effect relations, are still a black box. In this paper, the box is further disclosed by tracking back the underlying processes, resulting in a series of prototypes of detailed hypothetic cause-effect mechanisms. Applied to the adapted model, the results are initially tested on an iconic chocolate factory. Conclusions are drawn about the results and more generally about the usability and the further development of the model.

Keywords: life cycle analysis, obsolescence, conversion non-residential, feasibility, building pathology.

1. Introduction

What is the potential lifespan of buildings, and how can the useful service life be extended?
Buildings do age. But unlike living creatures, the effects of the ageing of buildings can and must be counteracted by maintenance, improvement or adaption, on pain of obsolescence and decay. In particular obsolescence is a serious threat for built property and the physical, economic and societal investments incorporated in buildings. Insight in obsolescence is also important because of the on-going paradigm shift from new construction to maintenance and improvement of the existing housing stock. Depending on the researcher's discipline, the answer was sought in the physical condition of the building, the market value of the property, the behaviour of the proprietor, the prosperity of the neighbourhood, the quality of the environment etcetera; but despite some earlier attempts, a broad applicable integrated approach was not available. To close this gap, Thomsen and Van der Flier (2011) developed a holistic analytical model of obsolescence, meanwhile further developed and elaborated for residential buildings. In previous stages of the research we have reported about the further development of the model, the search for indicators and instruments to trace and measure different types of obsolescence and the testing of the model (Thomsen and Van der Flier, 2013; Nieboer et.al. 2014). The results showed that the model is useable and further development is feasible and promising, but a number of difficulties should be resolved, missing information gained and complexities tackled, all related to a better understanding of the core dynamics of obsolescence and the underlying cause-effect processes resulting in declining performance of buildings, the 'black box' of obsolescence (Thomsen et.al. 2015). This paper is dedicated to that task. The further development of the model as reported in this paper consisted of the elaboration of a series of hypothetic interrelated cause-effect mechanisms and prototypes. The paper describes the way this was done, the results and the adaption of the model, as well as a first application in a case study (Thomsen and Carels 2016).

1.1. Approach

To approach the black box and more specifically the underlying cause-effect relations, three directions are conceivable: an extended search for findings from sources in a wider domain, in particular similar and/or related models concerning the process of declining performance and a laborious time and resources consuming search by means of systematic cause-effect analyses in a detailed series of case studies. In between these two it may also be worth to search for logic relations by hypothetic reasoning (Thomsen et.al. 2015).
The hypothetic prototypes described in this paper are mainly the result of the latter. For practical reasons the scope is narrowed to residential buildings.

1.2. Problem definition and research questions

The problem definition in this stage of the research was: What are, starting from the analytical model of Thomsen & Van der Flier, the determining cause-effect processes underlying obsolescence and decay of buildings, how are they interrelated, how do they work and what is their significance for the life cycle and life span expectancy?

This problem definition is divided in the following research questions that structure this paper:

1) What are the major cause-effect processes determining the life cycle and life span expectancy of buildings?
2) What is their character, how can they be determined, how are they interrelated and how do they work?
3) What can - by using a system of cause-effect prototypes - be learned from the life cycle and the process of obsolescence of the building and its functional and structural potencies and weakness in view of reuse?
4) What can be learned of the applicability of the prototypes?

These questions will be successively answered in the next sections. Question 1 will be answered in section 2, question 2 in section 3, question 3 in section 4, and question 4 in the concluding section 5.

2. Understanding obsolescence, the analytical model of Thomsen & Van der Flier

Buildings do age. But unlike living creatures, the effects of the ageing of buildings can and must be counteracted by maintenance, improvement or adaption, on pain of obsolescence and decay. In particular obsolescence is a serious threat for built property and the physical, economic and societal investments incorporated in buildings. Insight in obsolescence is also important because of the on-going paradigm shift from new construction to maintenance and improvement of the existing housing stock.
This section answers research question 1.

2.1. Obsolescence: definition and knowledge sources

Obsolescence can be defined in various ways: by causes, by effects or by elements (Markus et al., 1972; Nutt et al., 1976; Iselin and Lemer, 1993; Golton, 1997). In this paper obsolescence is broadly approached from both the technical and the behavioural domain. Following Miles et al. (2007) obsolescence is defined as the process of declining performance resulting in the end of what Awano (2006) calls the service life of buildings. Performance is defined as the extent to which buildings meet requirements, the formulation of which depending on the interests of the involved stakeholders. Despite the complex, multifactor and interrelated character of obsolescence, many studies only focus on one side of the phenomenon: on the technical, spatial or the economic side, or on the behaviour of the main actors, and the scope varies from single objects to stocks of different scale and tenure. There is only a small stream of studies that combine the various ways to look at the performance of buildings in a comprehensive approach. Examples are Prak and Priemus (1986) on the level of estates and Grigsby et al. (1987) on the level of neighbourhoods. More recently, Thomsen (2012) proposed a holistic approach inspired by the diagnosis-treatment model that is used in the field of pathology and elaborated for the building sector in the so-called building pathology (Harris, 2001; Watt, 2007).

2.2. The Thomsen & Van der Flier model

An earlier literature survey conducted by the authors (Thomsen & Van der Flier, 2011) showed the variety of science domains and viewpoints from which obsolescence of buildings can be approached: technical, including architecture, construction and planning; and behavioural, including economy, sociology and management. The literature survey concluded that obsolescence basically consists of interrelated cause-effect processes on two dimensions that emerged as most distinguishing:

(1) the character of the cause-effect relation: physical (related to the built artefact) or behavioural (related to the behaviour and actions of the main stakeholders, i.e. owners, residents and other users); and

(2) the origin of the cause-effect relation: endogenous (i.e. from the building itself), or exogenous (i.e. from the environment)[1].

Combined in a quadrant matrix the two dimensions result in a model with four types of obsolescence (see Figure 1):

(A) endogenous physical obsolescence: decline of the performance of the building by physical cause-effect processes within or directly related to the building itself, e.g. poor or substandard initial quality, physical decay, insufficient strength, leakage;

(B) exogenous physical obsolescence: decline of the performance of the building by physical cause-effect processes from outside the building, e.g. air pollution, acid rain, poor infrastructure, traffic noise and earthquakes;

(C) endogenous behavioural obsolescence: decline of the performance of the building by behavioural cause-effect processes within or directly related to the building itself, e.g. behaviour of the main stakeholders, (ab)use and (mis)management; and

(D) exogenous behavioural obsolescence: decline of the performance of the building by behavioural cause-effect processes from outside the building, e.g. poor liveability, declining market appreciation, adverse or failing government policies.

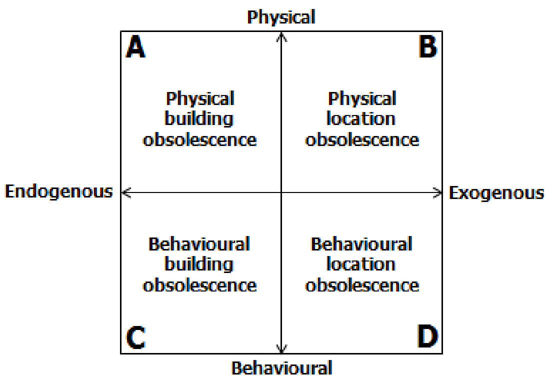

Figure 1. Analytical model Thomsen & Van der Flier (2011)

Combined the two distinctions result in a model with four quadrants that typify various ageing processes c.q. types of obsolescence (Figure 1). The quadrants are characterized by the underlying cause-effect mechanisms and not by their physical appearance. E.g. quadrant 'A' regards decline of

[1] This denotation of the terms endogenous and exogenous is different from the usage in economic models. The latter could possibly be used for the behavioural, but not for the physical dimension.

performance of buildings by physical cause-effect processes within the building, e.g. poor or substandard initial quality resulting in defects. These mechanisms can be complex and also interrelated. Due to this, it is sometimes difficult to identify the type of obsolescence, for example in a case where present decay is caused by a deliberate choice (a behavioural aspect) of substandard materials (a physical aspect) in the past. Nevertheless, it can be argued that complexity and interrelationship and related "wicked problem" difficulties as such are no valid reasons to refrain from a classification for analytic purposes.
The model was further developed as a broad tool to detect and analyse obsolescence. To identify and assess the impact of the various cause-effect processes, a range of existing instruments and approaches were inventoried (Figure 2).

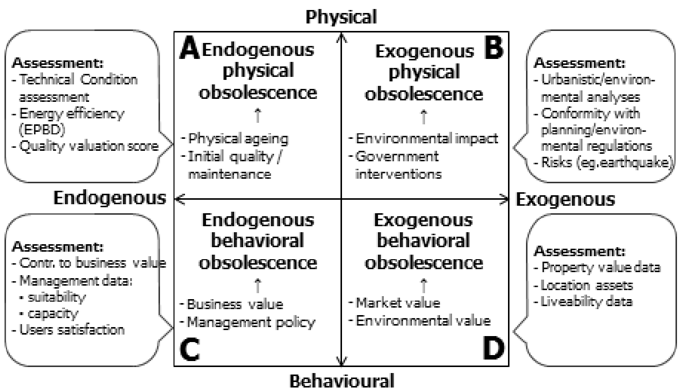

Figure 2. Extended Analytical model Thomsen et.al. (2015)

After a series of case studies, tests, analyses and discussions (Thomsen and Van der Flier, 2013; Nieboer et.al. 2014), the conclusion was that with the results so far, the development and testing phase were sufficiently successful to be continued with the next step, being the further development of the model as a diagnostic tool (Thomsen et.al. 2015). A first requirement for this step is that a number of difficulties should be resolved, missing information gained and complexities tackled, all related to a better understanding of the core dynamics of obsolescence and the underlying cause-effect processes resulting in declining performance of buildings, the 'black box' of obsolescence.

3. Better understanding obsolescence: towards a diagnostic tool.

Knowledge about causes and cause-effect processes may not be necessary for diagnoses, it is essential to understand how obsolescence works and will eventually be indispensable for a diagnostic tool for possible treatment and prevention.
This section answers research question 2.

3.1. Cause-effect processes types and mechanisms

The model is based on the hypothesis that the core dynamics of obsolescence consists of a series of complex interrelated recurrent cause-effect processes within and in between the four quadrants of the model, resulting in the eventual performance decline of buildings. Though these cause-effect chains are fundamental for all kind of ageing and decay processes, systematic interdisciplinary research has been very limited up to now, to as far as we know specialized fields as aircraft and automotive manufacture and maintenance, but not in the built environment. The advance of these cause-effect in that field is still a black box. For that reason, the research in this section carries necessarily a tentative and preliminary character.

Table 1. Cause-effect process types

type	Cause		effect	
A→A	A	physical defects; design errors; poor hydrothermal quality	A	consequential damage; condensation, rot; functional defects;
A→B			B	environmental damage; shadow, wind, reflections; environmental effects;
A→C			C	loss of demand, nuisance; discomfort, energy waste; owner/ user disinvestment;
A→D			D	liveability effects; insecurity; loss of demand; depreciation
B→A	B	environmental defects; planning errors; climate/ earthquake impact	A	physical damage; material damage; functional defects;
B→B			B	consequential damage; spatial obsolescence; environmantal insecurity;
B→C			C	nuisance; discomfort; owner/ user disinvestment;
B→D			D	liveability losses; insecurity; loss of demand, nuisance; depreciation;
C→A	C	loss of demand; discomfort; misuse, neglecting; disinvestment	A	maintenance backlogs consequential damage; loss of condition
C→B			B	maintenance backlogs environmental damage; environmental effects;
C→C			C	(increased) discomfort; misuse, neglecting; disinvestment
C→D			D	liveability losses; insecurity; loss of demand, depreciation;
D→A	D	liveability defects, insecurity loss of demand depreciation	A	maintenance backlogs consequential damage; loss of condition
D→B			B	maintenance backlogs environmental damage; environmental effects;
D→C			C	(increased) discomfort; misuse, neglection; disinvestment
D→D			D	(increased) liveability losses; insecurity; loss of demand, depreciation;

An obvious further step to understand and analyse these processes is to systematically identify all possible cause-effect relations within and in between the for quadrants of the model and examine the most plausible causes and effects. As a result, a series of 16 interrelated cause-effect process prototypes can be distinguished (the characters refer to the four quadrants of the model: A □A, A□B etc.). Combined with the three most relevant cause and effect examples per prototype as derived from

the above-mentioned literature survey and case studies results in 48 detailed cause-effect process types as shown in Table 1.
The table leads to the following observations:

- Considered are only hypothetic single sided cause-effect processes. In practice, they may often be more complicated and intertwined. In what way and to what extent these processes occur in practice has to be further investigated.
- Cause-effect processes are by nature highly dynamic, interrelated, intertwined, and interaction and intervention dependent. Their character and effect can only be determined by systematically repeated examination covering at least the most relevant life cycle phases.
- Though characteristically negative, cause-effect processes can also have positive effects, whether or not intended and/or arranged by targeted interventions as e.g. maintenance, reinvestments or management measures.
- Not by chance the impact of different causes on the same quadrant results in similar effects. And, as effects will at their turn act as causes, cause-effect processes will in practice appear as prolonged recurrent interrelated cause-effect chains.

4. Case study: The Ringers Chocolate Factory

The adapted model as described above has been tested in a few case studies, residential, non-residential and mixed use. The case study as described below is a large non-residential building, the Ringers chocolate factory in the Dutch town of Alkmaar.
This section answers question 3.

4.1. The Ringers factory, building history and significance

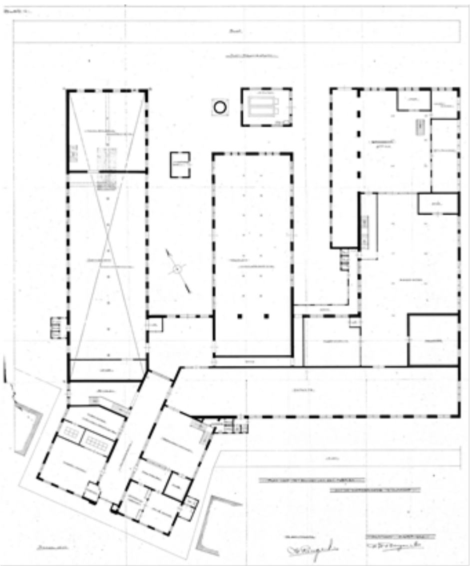

Figure 3. Masterplan 1920

Ringers was once a famous chocolate manufacturer. The Ringers factory building dates originally from the interbellum and was especially designed for the manufacture of chocolate. Situated opposite the historic city of Alkmaar as the first building on the north shore of the Noord Hollands canal and designed in a Frank Lloyd Wright inspired Amsterdam school of architecture style, it has been part of the mind-set of local peoples for ages. Following a masterplan, the building was steadily extended to its actual volume, being only half of the originally intended final state (Figure 1).

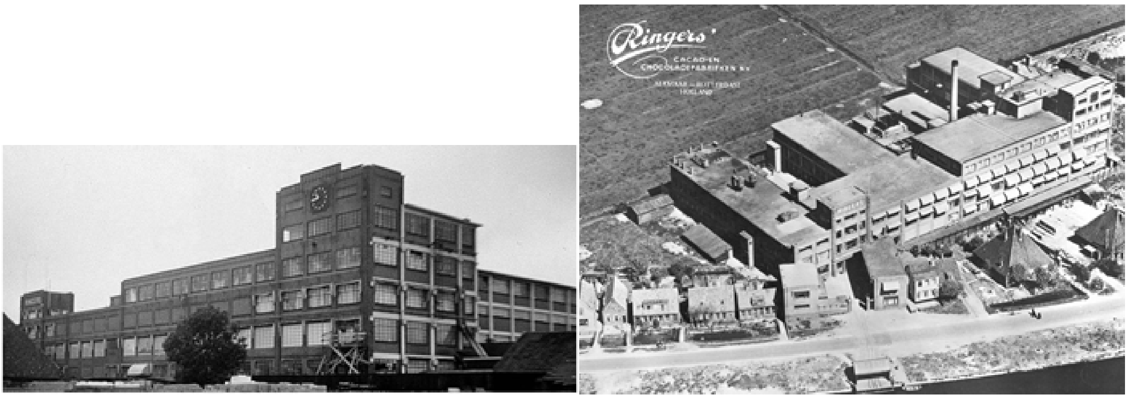

Figure 4. Façade 1937 and Aerial view 1940

Before the mirror symmetric east wing was realized, the factory closed and the building was sold to Klercq, a large home furniture company, whereupon the interior was converted into a furniture store, the courts were covered and converted into retail space and the monumental brick façade was covered with white synthetic cladding and the capital name on the façade was changed in Klercq as it is today (Figure 2). In everyday language though the name of the building remained Ringers.

Figure 5. Ringers as Klercq, 2007.

After the bankruptcy of Klercq in 2007, most floor space was vacant and at the end of the first decade of the 21st century most shops were closed and different plans were made for redevelopment with mixed functions (retail, education, offices, housing) but the new owner, the real estate developer MAB, part of the Rabobank, wanted demolition.

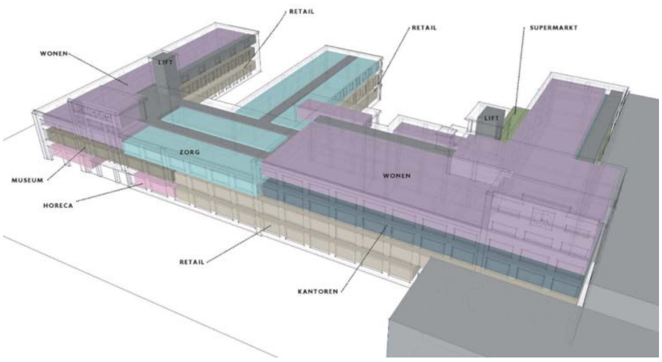

Figure 6. Reuse and transformation study (BOEI 2014)

After the local heritage association Alkmaar (HVA) started to mobilize public opinion to maintain and transform the Ringers building as important industrial heritage, and under pressure as a result of the real estate downturn following the subprime crisis, the property developer and the municipality slowly changed policy, giving way for redevelopment with conservation and reuse, for which BOEI - a ngo specialized in redevelopment of industrial heritage – made a feasibility study (Figure 3, BOEI 2014).

More recently Dobla Chocolate is willing to return a large part of Ringers to its original function (the past is the future!) and has succeeded in acquiring other participants for a balanced business case presented in July 2015. This new initiative and growing consensus about the importance of the building, is supported by the city council. Ringers was officially declared a monument on the 12th of April 2016.
Table 3 (Appendix) contains a concise overview of the different building stages, subdivided into proprietor/main function.

4.2. Relevant life cycle phases

Not all of the building phases as described in Table 3 are in the same way significant for the performance development of the Ringers building. Relevant are only development changes with a decisive effect on the life cycle. Overlooking the building history, the most decisive stages for the building's life span development were op to date (numbers refer to Railing 2012):
I. The main initial phase (1-10).
Resulting in the final E-shaped floorplan, this phase is determining for the initial building quality and performance capacity, specifically as a chocolate factory, but regarding building morphology, structure and spatial characteristics also for future change of use. The successive enlargements and additions did not change much of these characteristics. World war II and the preceding economic crisis had far-reaching effects, particularly on the economy, but the Ringers company stayed in business and effects on the Ringers building were hardly notable; during the war, there was even a substantial enlargement.
II. The heyday phase (11-18).
After the war the business revived rather soon and the increasing production was exported to 26 countries all over the world. Though the building was further extended and adapted a clear impact of this period on the life cycle is insignificant.
III. First decline (18-19).
(19-25). After the initial phases the company closure in 1973, followed by the acquisition by the Klercq furniture company and consecutive transformation as a home and furniture store was the first critical occurrence with decisive impact on the building, including - apart from adaptation of the interior- replacement and renewal of the main entrance.
IV. Extended use phase (19-26).
The transformation turn into success and resulted in several further alterations and additions, e.g. the complete cladding of the waterfront façade by rounded white synthetic sheets in 1982, intended to give the building a fresh contemporary facelift, addition of an external elevator and staircase, and adaptation of the N-facing courts and façades for i.a. consumer electronics retail.
V. Second decline (26-28).
The second critical and possibly fatal occurrence was the closure after bankruptcy of the Klercq company in 2008 leaving most of the floor space empty and making the future of the building part of the discussions about the revitalization of the ageing surrounding shopping area. The acquisition of the Ringers building by MAB to be removed and replaced by a new shopping mall would under unchanged circumstances have resulted in the end of the Ringers story. The worldwide economic crisis combined with the resistance of the local heritage association HVA and the retreating MAB made a game change and the demolition plans faded away.
VI. Redevelopment phase (28-34).
The participation of the redevelopment specialist BOEI made the municipality taking distance of their previous plans and convinced former opponents of the promising side of redevelopment of the building. A plan to establish a regional pop-music centre in Ringers was rejected though by the city council in favour for a new building. The entry of Dobla Chocolate Creations and its success in acquiring sufficient other participants for a balanced business case may open an unexpected second life for Ringers as chocolate factory.

4.3. Analysis

The analysis is based on the cause-effect process prototypes as described above and depicted in Table 1. Data for the indicators used are derived from the available sources and recent surveys by the author (2016). Where older qualitative data are absent they have been approximated by reasoned guesses. Applying the cause-effect types to the above described phases results in Table 2 (Appendix), showing the relative impact of identified cause-effect processes on the building performance over time. Due to the limited accuracy of the data, the scores are on a five-point scale, varying from very negative (--) to very positive (++).

4.4. Discussion

As Table 3 shows, the cause-effect prototypes enable an improved and objectified view on the determining mechanisms underlying the successive life cycle stages of the building. The answers on research question 2) what can be learned from the life cycle and the process of obsolescence of the building and its functional and structural potencies and weakness in view of reuse, are as follows.
The case clearly shows the interrelated multifaceted character of obsolescence. The determining cause-effect processes underlying the performance development of the building are found in all quadrants A, B, C and D. Noticeable are the relative positive impacts in the A- and also in the B- and D-quadrant, illustrating the strong influence of the initial building- and location quality. Against this stands the determinative impact of the decision making of the proprietor answering market and business circumstances. As is once again the fact, obsolescence is hardly a matter of physical decay but mainly the result of behaviour, either by the proprietor and/or due to property market dynamics; in the case of Ringers being the merger and resulting closure by the Ringers management and the bankruptcy of the Klercq management, but also the role of MAB and recently Dobla. The last phases show also the vulnerability of the building as an unprotected industrial heritage and the strong dependency on the municipal policy agenda, that varied from the market directed laissez-faire to finally the assignment of a heritage protected municipal monument. In the end the strong architectural, structural and multifunctional qualities of the building turn out to be still its basic strengths, giving solid opportunities for reuse.

5. Conclusions

Based on the answers to the research questions as concluded in the previous sections, the conclusions are as follows:
1) What is the architectural and structural building history and the resulting determining characteristics of the building?
The building history reveals the development of the Ringers building as a unique and consistent architectural piece of art, resulting from a unique family cooperation, with a strong basic quality that served and survived different functions and proprietors and has become part of the collective consciousness of the civil society in Alkmaar.
2) What can be learned from the life cycle and the process of obsolescence of the building and its functional and structural potencies and weakness in view of reuse?
Looking at the different phases of the building's history, the life cycle analysis clearly shows the interrelated multidimensional character of the performance development, it's strengths - being the initial building and location quality - and it's vulnerabilities - being the dependence on proprietors, market developments and governmental and municipal policies and, in particular, the vulnerability of unprotected (industrial) heritage. As a consequence, solutions should in the same way be multidimensional, directed to as well the building as the behaviour of the key-actors.
3) What can be learned of the applicability of the cause-effect prototypes?

The application in this case enables an improved and objectified view on the determining mechanisms underlying the successive life cycle stages of the building. Transparency and rational reasoning and control of the decision making are the requirements necessary to prevent mistakes and to anticipate possible risks, for which purpose the analytical model is shown to be a valuable tool. The model itself does not directly point out the most appropriate approach for reuse, but enables a better analysis of the strengths, weaknesses, opportunities and threats on an ex-post basis and provides valuable input for ex-ante analyses.
Though the application in this case study is sufficiently promising, a broad series of applications in a wide range of building types, in particular in the residential stock, will be necessary to further develop, test and improve the model and the cause-effect prototypes. Thus: to be continued.

Acknowledgements

The author thanks Eddo Carels as his colleague researcher and co-author of the underlying case study (Thomsen and Carels 2016) whose efforts, though not involved in this paper, were of great value for the research. Kees van der Flier made the first steps on the way to the cause-effect prototypes. And he and Nico Nieboer gave valuable comments on the case study.

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Table 2. Impact analysis

Life cycle phase

Phase	Stage		Type	Description	Impact	Type	Description	Impact	Type	Description	Impact	Type	Description	Impact
I.	1-10	Initial phase	AA	New, well built and maintained construction. Good energy efficiency (to that time standard) with partly double glazed windows. Fine architecture. Well dimensioned multi-purpose spatial structure.	++	BB	Open industrial area with accordingly infrastructure: road, waterway, nearby rail and station. Full conformity with (that time) regulations. Absence of environmental threats or conflicting neighbour interests.	++	CC	(No data). Well suited as purpose specific designed.	++	DD	Attractive valuable property; accommodate various functions. Well situated: waterfront, direct road and waterway connection, nearby rail, station and city centre. Ample extension space	++
			BA	-	o	AB	-	o	AC	Positive working environment	+	AD	Attractiveness	+
			CA	Positive	+	CB	Positive	+	BC	Positive working environment	+	BD	Attractiveness	+
			DA	Positive	+	DB	Positive	+	DC	Positive working environment	+	CD	Attractiveness	+
II.	11-18	Heyday phase	AA	As above. Well maintained.	+	BB	As above. Development mixed industrial and commercial area.	+	CC	As above. Former workers still testify love.	+	DD	As above.	+
			BA	-	o	AB	-	o	AC	As above	+	AD	As above	+
			CA	As above	+	CB	As above	+	BC	As above	+	BD	As above	+
			DA	As above	+	DB	As above	+	DC	As above	+	CD	As above	+
III.	18-19	First decline	AA	As above; emphasis on adaptability spatial structure. Energy efficiency stays behind.	+	BB	As above. Further development of adjacent shopping area.	++	CC	Closure due to negative profitability.	--	DD	Acquisition indicates acceptable market value.	+
			BA	-	o	AB	-	o	AC	-	o	AD	Attractiveness	+
			CA	Stop on investments	-	CB	Impact closure, no noted effect	o	BC	-	o	BD	-	o
			DA	As above	+	DB	As above	+	DC	Positive incentive	+	CD	Impact closure, no noted effect	o
IV.	19-26	Extended use phase	AA	Still as above, but alterations of lower quality, partly harming architecture (cladding façade); insufficient energy efficiency.	-	BB	Development of Overstad with changed urban plan: shopping centre, leisure, housing.	+	CC	Acquisition and investments indicate cost effective operation.	+	DD	As above.	+
			BA	-	o	AB	-	o	AC	-	o	AD	Impact cladding, no noted effect	o
			CA	Low maintenance investment	-	CB	-	o	BC	-	o	BD	-	o
			DA	-	o	DB	-	o	DC	No data		CD	-	o
V.	27-32	Second decline	AA	Increasing maintenance backlogs but still valuable architecture and solid structural condition	-/o	BB	Redevelopment of Overstad; changed urban plan enables demolition.	-	CC	Closure due to bankruptcy, followed by closures due to negative profitability	--	DD	Economic recession, bankruptcy of owner. Acquisition for removal likely negative for value.	-
			BA	-	o	AB	-	o	AC	-	o	AD	Impact maintenance backlog	-
			CA	No maintenance investment	--	CB	Impact vacancy, no noted effect	o	BC	-	o	BD	-	o
			DA	Some vandalism	-	DB	-	o	DC	Positive incentive, no effect	o	CD	Demolition plan of new owner	-
VI.	33-34	Redevelopment	AA	Consequential damages but still valuable architecture and solid structural condition	-/o	BB	Upgraded urban plan; formal monument status → heritage protection	++	CC	Policy change developer, willing to sell	+	DD	Ongoing negotiations/ retreat MAB/heritage protection → unknown effect on market value.	o/-
			BA	-	o	AB	Reconsideration urban planning	+	AC	Maintenance backlog	-	AD	Impact maintenance backlog vs. good reuse opportunities	o/+
			CA	No maintenance investment	--	CB	Impact vacancy, no noted effect	o	BC	-	o	BD	Positive value outlook	+
			DA	-	o	DB	Reinvestment opportunities	+	DC	Lower market value = chance	+	CD	Coalition for redevelopment	++

Table 3. Building history, stages and phases

Phase	Stage *)	Year	Owner	Main function	Intervention Physical	Process	Description
I.	0	1920	Ringers			X	Decision to return main production from Rotterdam to Alkmaar
	0	1920-21		Chocolate factory	X		Initial design and realisation NW-wing (3 floor)
	1	1922			X		Addition N-wing (3 floor)
	2	1925			X		Temporary connection shed
	3	1926			X		Addition main building SW-part (3/4 floor), addition gatehouse, boiler house
	4	1927			X		Addition NE-wing (1 floor)
	5	1928			X		Addition liquor distillery (1 floor) between stage 1 and 4
	6	1929			X		Addition boiler house
	7	1930			X		Roofing and extension canal quay
	8	1932			X		Build up gatehouse (2nd floor)
	9	1937			X		Final extension main building SE-part (4/5 floor)
		1940-45				X	WW-II; Rotterdam factory destroyed by German bombing
	10	1940			X		Build up NE-wing (stage 4, 4 floor), shedroof on interspace stage 1-4
II.		1945-65				X	Increasing production, export to 26 countries
	11	1948			X		Extension gatehouse with bath- and dressing room
	12	1949			X		Addition paper storage SE-corner
	13	1950			X		Addition shedroof and elevator interspace stage 0-1; renewal canal quay
	14	1951			X		Extension main building between stage 1-5 (4 floor)
	15	1956			X		Extension NW-part NW-wing (shedroof, 1 floor)
	16	1957			X		Extension warehouse, gate fire brigade
		1960			X		Free standing single floor building for car maintenance N of E- court
	17	1961			X		Extension N-wing (2 floor)
	18	1963			X		Minor additions: fire brigade facility, transformer room
		1964			X		Larger building for technical services NW-side.
		1965			X		Temporary lodge, NW-side; last Ringers construction.
III.		1969				X	Grave competition by cheap mass supply; merger with Cavenham Foods Ltd
		1970				X	Take-over by competitor Royal Droste
		1973				X	Closure, acquisition by Klercq home and furniture store
IV.	19	1974	Klercq	Furniture store	X		Conversion to furniture store, removal gatehouse etc, upgrade main entrance
	20	1982			X		White synthetic cladding on main S-façade
	21	1983			X		Addition of exterior elevator and staircase on main façade
	22	1987		+Store	X	X	Redesign with new roofing vault on NE-court for new retailer
	23	1988			X		White synthetic cladding on NW-façade
		1988		+Electronics store	X	X	Conversion NW-court and new entrance for electronics retail store De Block
	24	1993		+Bicycle store	X	X	Addition of shopping and repair space for bicycle store on NW corner.
		1993			X		Extension E-side main building for storage
	25	1996			X		Build up main building (stage 3) with 5th floor
	26	1997				X	Realisation adjoining shopping centre Noorder Arcade and Ringers bridge.
V.	27	2008				X	Closure after bankruptcy Klercq; acquisition by MAB property development
	28	2008	MAB	Redevelopment	X	X	Most floorspace vacant, increasing maintenance backlogs
	29	2011			X	X	HVA (Heritage Society Alkmaar) starts campaign for preservation
	30	2011				X	Municipality publishes urban plan Overstad enabling new development
		2011				X	MAB presents design replacing shopping mall with Ringers lookalike façade
	31	2012				X	Municipal initiative for expert team MAB-HVA; MAB to consider reuse
		2012				X	HVA submits request for formal heritage protection of Ringers
	32	2013				X	Bankruptcy De Block consumer electronics; almost complete vacancy.
VI.	33	2013	MAB/			X	MAB to terminate activities; BOEI (redeveloper industrial heritage) enters.
		2013	(BOEI)			X	Regional pop-music centre in Ringers? City council votes for new building.
		2013				X	Dobla Chocolate manufacturer wants to step in, looking for other investors
	34	2014				X	Refurbishment adjacent Noorder Arcade shopping centre after vacancies.
		2015				X	Continuing uncertainty and increasing maintenance backlogs

*) Source stages 0-25: Ralling (2012)