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Reclamation Costs and their Weight in the Economic Sustainability of a Project

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Abstract

Since the late 80's, reclamation of former industrial sites has become one of the most debated issues, nationally and internationally. This is due to the presence of toxic and harmful substances in the soil and subsoil, and to the need to regain, functionally, those areas that represent "urban voids" within the cities.
Negative effects generated by the presence of abandoned sites are essentially attributable to the increased amount of diseases (even serious ones) affecting the population who lives near those areas and to the related higher costs needed to ensure health care; to the costs (often public) for implementing measures finalized to secure those sites; to the revenue losses that the non-use of those areas determines for the public entity, and to the negative effects generated towards the development of other activities located nearby (Meyer, 2003). The expansion of the cities has incorporated these areas inside their structure; those became strategic also for the provision of public services such as green areas, parking lots, etc.. The restoration of former industrial sites collides with some critical issues related to the uncertainty on the level of pollution and, therefore, to the consequent reclamation costs and to the time required for their approval, as well as to the uncertainty about who should be in charge of this operation. The valuation of the economic and financial feasibility thus becomes the tool that, not only allows identifying possible solutions for the recovery of former industrial sites, but also allows identifying risk factors that threaten the success of the operation.
This work, after a presentation of the topic and an attempt to analyse parametrical costs for completed works, presents a case study of a former factory in Lentate sul Seveso, the "Tessitoria Schiatti", now abandoned, on which a series of project has been developed within the Workshop of Architectural Project and Constructions held in Polytechnic of Milan[1]. Each work-group verified the economic and financial sustainability of its project through the application of a discounted cash-flow analysis (DCFA) model. All the models revealed that reclamation costs strongly affected the sustainability of those projects; those, in fact, cannot be paid entirely by the ones who develop the operation, but they need an external economic support in order to ensure the

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financial feasibility of the intervention.

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1. Introduction

Because of the industrial development that has characterized numerous countries after World War II, many industrial sites have been located in the suburban areas of the cities. Those industries have ensured the employment and the economic welfare of a number of generations and have triggered urbanization phenomena of a large portion of population who have moved from the countryside to the city in order to search for a job. With the spatial reorganization of production processes and the changes in regulations, since the late 70's a gradual relocation of industrial activities has begun. It often happened toward foreign countries, toward other areas that are more accessible or that require lower labour costs. This circumstance led to the abandonment of former industrial sites that were near the urban and living area. In addition to the many brownfields there are, also, military facilities (such as stations, shooting ranges etc.), which are no longer functional to the training activities, that the Ministry of the Defence gave to the State for their valorisation, even through the cession to third parties (public or private) after the submission of a valorisation plan. The phenomenon of industrial sites to be reclaimed and recovered for other uses affects all the most industrialized countries. According to Environmental Protection Agency (EPA), only in the United States there are about 450.000 abandoned sites (US Environmental Protection Agency); in the six major industrialized European countries (Germany, UK, France, Holland, Belgium and Italy), to date, about 215,600 hectares of abandoned industrial areas are counted (Rho, Tonin & Trombetta, 2002), many of which require remediation from pollutant. Because of their dimension and location within the urban structure, the recovery of these areas and buildings is strategic for the economic and social development of the city. In addition to the establishment of new sustainable productive activities, from an environmental point of view, they allow the provision of those services that in many cities are still missing (such as green areas and spaces, sport facilities, etc.), which contribute to the quality's improvement of the citizens lives.

Promoted restorations of those areas represent also a great catalyst for private investments: the Council for Urban Economic Development (CUED) (Council for Urban Development, 1999) has analysed 107 remediation promoted by the American Government, and found out that, for every dollar spent, this triggers 2.48 dollars of private investments on the area; furthermore, every 14,000 dollar spent on the reclamation of the area, a new job is generated.

The conversion of former industrial areas has to face with the high costs of operations for the reclamation of pollutant in the soil and subsoil, legacy of previous activities. At least nationally, difficulties related to cost estimates (which are strictly dependent on the level of pollution and the type of toxic substances that are there) and complex regulatory system represent the major critical issues that need to be deal with in order to verify the financial and economic sustainability and to plan the operations, otherwise hindering the development of recovery and valorisation initiatives.

2. The former industrial sites in Italy and the reclamation costs

There are several definitions of abandoned land to be reclaimed; the EPA of the United States defines those as "a property whose development or reuse may be hindered by the presence - or the possible presence - of pollutants" (US Environmental Protection Agency); in Europe, the network CLARINET (Contamined Land Rehabilitation Network for Environmental Technologies) defines them as "abandoned or underused sites characterized by a

contamination, perceived or real, mainly located in urban areas that need interventions for their re-use" (CLARINET , 2002).

Even if every European country has defined its own legislation on the subject, all the laws are based on the principle of "the one who pollute pays", i.e. the person who has produced some environmental damage has to contribute to the costs for safety measures and for the necessary remediation. While presenting some differences about the arrangements for implementing the interventions and the identification of people to be involved in their design and management, each of them conform to the European Directive 2007/35 / EC. This Directive is implemented nationally by Dlgs. n. 152/2006 "Environmental Regulations" which deals with the environmental remediation at the Title IV of Part IV. Article 245 imposes, on the actual responsible for the contamination, remediation's duties, which become optional (and then only on a voluntary basis) for the person who is interested but not responsible (ex.: new site owner). The same article also states that, if the responsible for the pollution cannot be identified, cleaning up cannot be coercively leaned against third parties - even interested – but, instead, it has to be carried out by competent authorities (in this case the Ministry of Environment and the affected region). The estimate of these remediation costs becomes, therefore, a fundamental matter, both for their efficient technical and economic planning, and for triggering the revive processes in those areas, also through the involvement of private entities. Internationally, the estimated remediation costs is largely developed on former mining or industrial areas; the specificity of the interventions makes the parameterization of the costs very difficult; these are mostly expressed in unitary terms according to the size of the individual finished work (Catlett & Boehlje, 1979; Misiolek & Noser, 1982; Kun, Malli & Tufan, 2012; Janikowski & Korcz, 2003). Kaufman, Rogers and Murray have described, however, a regression model for the estimate of remediation costs based on the type of pollutants, soil type and the level of risk (Kaufman, Rogers & Murray, 2005). Implementing the art. 252 on the Decree n. 152/2000, the ISPRA (Institute for Environmental Protection and Research) has identified 57 "sites of national interest" (SIN) classified according to the characteristics of the site, to the quantity and the dangerousness of pollutants, to the impact on the surrounding environment in terms of health and ecological risk as well as the detrimental effects on cultural and environmental heritage (ISPRA).

After the Decree of the Ministry of 11 January 2013, these sites were then reduced to 39, for a total area of about 100,000 hectares. It is estimated that there are more than 6,000 local SIN; about 6 million people live nearby and their reclamation costs are approximately equals to € 30 billion. From the experience derived from previous interventions, detected by different sources and classified in an ad-hoc-analysis conducted by Polytechnic of Milan's Real Estate Valuation Center , it is clear that the time needed for this kind of interventions is particularly extended. This is due also to the complexity of the analysis to be developed and to the obtainment of the necessary approvals carried out by competent authorities. According to data from ISPRA, the average investigation time needed for an operation is approximately 12 years; in addition to the time-factor, a further criticality is the cost-factor. Referring to a first series of remediation's cases, 48 SIN, there was an average cost per square meter including also investigation, technical design and monitoring (after the operation), of € 169; € 141 of which, are only related to the implementation (Table 1). The swing range is, however, very wide: it goes from a minimum of about € 8 to a maximum of about € 1,105.

Table 1. Reclamation cost detected in 48 Italian ex industrial sites

Cost	Average cost		Minimum cost		Maximum cost	
	Total (€)	Unitary (€/sqm.)	Total (€)	Unitary (€/sqm.)	Total (€)	Unitary (€/sqm.)
Investigation	98,690	18.6	6,714	0.6	537,115	100.7
Work	1,149,412	140.5	20,142	5.6	11,413,697	1,037.6
Monitoring	79,671	9.5	6,714	0.6	3,824,228	33.6
Total	*1,327,774*	*168.6*	*33,570*	*7.51*	*12,152,231*	*1,104.7*

The analysis of unitary reclamation costs in relation to some physical characteristics of the area is very interesting.

With respect to the size, there is a reduction in the unitary cost as the dimension of the area to be reclaimed increases: the maximum unitary cost, of about € 709 per sqm., can be found for the dimensional category up to

1,000 sqm., while the minimum one, equal to about € 23 per sqm., can be found for sites that have an extension of more than 100,000 sqm. (Table 2).

Table 2. Unitary reclamation costs by size of the sites (Source: ISPRA)

Area (sqm.)	Unitary cost (€/sqm.)
<1,000	708.60
1,001 – 2,000	283.40
2,001 – 20,000	123.60
20,001 – 100,000	44.10
>100,000	22.90
Average	*168.60*

According to the type of the soil, however, major costs are detected in marshes (about € 709 per sqm.), where pollutants penetrate more deeply and reach the aquifers, and in the former quarries sites (about € 2002 per sqm.); while the lower ones are can be found in rivers (about € 183 per sqm.) and flat areas (about € 151 per sqm.) (Table 3).

Table 3. Unitary reclamation costs by type of land (Source: ISPRA)

Type of ground	Unitary cost (€/sqm.)
Swampy area	708.60
Quarry	202.40
River area	182.60
Flat area	150.90
Average	*168.60*

The reclaiming costs also decrease according to the land-use: the lowest are required for a future residential use (around € 106 per sqm.) and the highest for an industrial one (about € 189 per sqm.) (Table 4).

Table 4. Unitary reclamation costs for land-use destination (Source: ISPRA)

Land use	Unitary cost (€/sqm.)
Industrial	189.30
Agricultural	171.80
Residential	106.10
Average	*168.60*

The high variability of unitary costs highlights the difficulty to assign a parameter to cost values that is useful for the economic planning of this type of operations. It has to be correlated also to the small size of the sample, as well as to the variety of the technologies used for the construction of land reclamation, selected according to the toxicity of pollutants detected and to the type and morphology of the soil. Precisely, the heterogeneity of the data collected in an unstructured way, moreover, does not allow the identification of further significant parameters according to which extrapolate cost values, nor the constitution of a structured sample for this type of interventions.

3. The case study of the former "Tessitura Schiatti"

This case study deals with the verification of the economic and financial feasibility of some rehabilitation projects of the area now occupied by the former Schiatti factory, in the town of Lentate sul Seveso (Italy). These projects have been developed by students of the Workshop of architectural project and constructions held in Polytechnic of Milan. The area, until the 70's, has hosted a textile production that employed colouring agents. The

factory, founded in 1900, thanks to the use of the Jacquard looms that enabled, with a little labour, to implement complex designs, established itself in the international market by offering precious products and high quality. With technological progress, however, the original spaces became inadequate and it was inevitable to transfer the entire industrial site towards a more functional area according to new production requirements. At the time of the settlement the site was located outside the town of Lentate; but with the gradual expansion of the urban area, determined by the demographic and economic expansion that has characterized the second half of the last century, this has assumed an increasingly central position. Now, in fact, it plays a predominant role in the life and identity of Lentate sul Seveso and its inhabitants. Nowadays the complex is abandoned even if it has already been acquired, long time ago, by a private entity; the new owner has not developed any renovation work yet, both because of the real estate market crisis and because of the need of reclamation from pollutant that are there because of the former process of colouring textiles. Project solutions developed by each working group aimed at the upgrade of the former industrial area, as it was indicated in the Territorial Master Plan (PGT) of the City of Lentate sul Seveso. The already recognized aesthetic and symbolic value of the complex led groups toward design solutions that did not consider the complete demolition and reconstruction of the existing buildings but, instead, they opted for the recovery and adaptation, where possible, of the existing structures to new functions. In addition to the technical feasibility and urban planning, a cost-benefit analysis (ACR) for the verification of the economic and financial feasibility of each solution has been carried out; the sustainability indicators that have been adopted, in respect of which those obtained by the ACR model were compared, are: a positive financial NPV and a minimum of 10% financial IRR. All solutions have provided the setting up of a mix of functions, with residences, covering most of the gross floor area (SLP) realized, tertiary buildings, commerce and services. According to the PGT standards it is also required that, contextually, some facilities and services had to be given free of charge to the municipality in exchange of a reduction in infrastructure costs. Students' projects have resulted in the creation of about 21,500 square meters of gross floor area, of which about 4/5 consist on new buildings and 1/5 consists on former industrial buildings that have been recovered and renovated, leading to a total production cost, on average, of € 21 million (Table 5). The variability of the costs that have been estimated by the different work-groups is to be addressed to the different design solutions that have been developed, both in terms of intended uses and in terms of technological solutions adopted. The intervention on an area that once was strongly characterized by an industrial vocation inevitably implies the need for a preliminary soil remediation. In the specific case of the former Tessitura Schiatti, the remediation affects the area on which once there were buildings for dyeing fabrics, because such activity was carried out by using pollutants.

Therefore, a reclamation of considerable extension is required, even though it does not have to be very intense (the textile industry involves a kind of soil pollutant that is definitely less dangerous than the one used in other industries); this requires costs that have a significant impact within the total cost needed for the production of the project.

Table 5. Surfaces and production costs (including reclamation)

Group	Ex-novo (sqm.)	Recupero (sqm.)	Total (sqm.)	Total cost (€)	Unitary cost (€/sqm.)
1	16,000	3,500	19,500	25,616,000	1,313.64
2	11,000	3,500	14,500	13,792,000	951.17
3	23,500	6,000	29,500	21,338,000	723.32
4	15,500	4,500	20,000	21,405,000	1,070.25
5	19,500	7,500	27,000	24,752,000	916.74
6	19,500	2,500	22,000	21,011,000	955.05
7	20,000	5,000	25,000	19,852,000	794.08
8	22,500	3,500	26,000	23,895,000	919.04
9	9,000	7,000	16,000	21,060,000	1,316.25
10	22,000	4,500	26,500	23,892,000	901.58
11	7,500	3,500	11,000	17,349,000	1,577.18
Average	*17,000*	*4,500*	*21,500*	*21,269,000*	*989.26*

For the estimated remediation costs, according to the preliminary level of design, a unitary cost of € 108.00 per sqm has been assumed. This cost was deducted from the average cost of € 324.00 per sqm, calculated on the basis of the unitary remediation costs published in the Price list of the Engineers and Architects Milan College (College of Engineers and Architects Milan, 2014) and the average unitary cost determined by the analysis of ISPRA case studies (Tab. 4).

This cost was then reduced by 1/3 in order to consider also the type of remediation that had to be carried out; as said, it was not a particularly intensive one because of the low toxicity of the pollutants detected from the analysis conducted by the Lombardy Region and the Province of Monza Brianza. Besides that, for the costs of the preparation of the area, a value of € 10.00 per sqm has been assumed.

The entity of the area affected by reclamation (about 17,000 sqm.), has determined a total cost, only for remediation and site preparation, of approximately € 2 million (Table 6).

Table 6. Reclamation and preparation costs

Group	Remediation costs			Preparation costs		
	Unitary cost (€/sqm.)	Surface (sqm.)	Total cost (€)	Unitary cost (€/sqm.)	Surface (sqm.)	Total cost (€)
1	108.00	18,500	2,001,000	10.00	18,500	185,500
2	108.00	10,000	1,080,000	10.00	10,000	100,000
3	108.00	19,500	2,092,500	10.00	19,500	193,500
4	108.00	21,500	2,311,500	10.00	21,500	214,000
5	108.00	22,000	2,350,500	10.00	22,000	217,500
6	108.00	10,000	1,080,000	10.00	10,000	100,000
7	108.00	13,500	1,458,000	10.00	13,500	135,000
8	108.00	18,000	1,945,000	10.00	18,000	180,000
9	108.00	18,000	1,958,000	10.00	18,000	181,500
10	108.00	18,000	1,958,000	10.00	18,000	181,500
11	108.00	18,500	1,976,500	10.00	18,500	183,000
Average	*108.00*	*17,000*	*1,837,500*	*10.00*	*17,000*	*170,000*

For different design solutions developed by the working groups, these remediation and preparation costs have an impact, compared to the total production costs, that is very consistent: in average around 9% (Fig. 1).

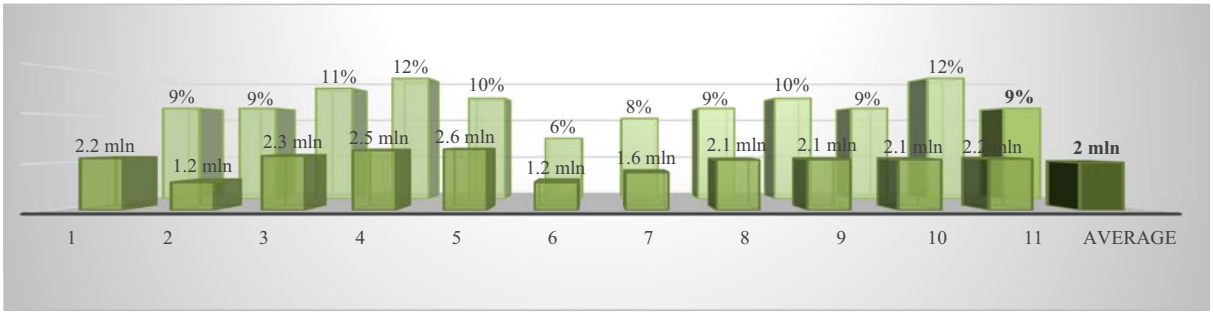

Figure 1 – Reclamation and preparation costs and its incidence on the total production costs

Therefore, for the feasibility of those operations, a wrong estimate of the costs, could determine a missing economic and financial sustainability of the intervention carried out by the individual investor.

In fact, it can be seen that when calculating the public contribution needed in order to ensure the feasibility of the operation (it is assumed to be donated entirely on the 5th year), if the costs of reclamation and preparation of the area aren't kept in count, it could suffer from a strong reduction that, for some interventions, can reach up to 92% (Tab. 7).

4. Conclusion

The analysis of the design solutions that have been developed shows that the economic and financial feasibility of the area is strongly affected by reclamation costs that, if approached only by the investor, almost eliminate the ordinary profit margin expected from an investment property. This is also due to the current state of the Italian real estate market, characterized by a strong decrease in demand and price for all intended uses, which further reduce profit margins and curb efforts to recovery these areas that are strategic for the construction or completion of many public services for the community.

If it is not possible to make the one who created the pollution support the remediation, the DCFA models have shown that minimum requirements for an economic and financial feasibility will only materialize if the public entity is going to cover a large part of those costs, as required also by the national legislation.

This would ensure financial returns that would be adequate to the risk that the investor is running and would promote the redevelopment of those sites that, in their current state, represent not only "black holes" but also an environmental and health risk.

The use of public resources for the remediation, then, can be seen as a kind of compensation for the community that, for decades, has been forced to live with this issue. The recovery and reutilization of those sites could provide, in fact, many of those public services (green areas, sports equipment etc.) that are now missing, and could develop, or revitalize, the local economy.

Table 7. Incidence of reclamation and preparation costs compared to the needed public contribution

Group	Public contribution (€)	Public contribution* (€)	Save (€)	Percentage (%)
1	17.903.000	14.625.000	3.278.000	18
2	12.293.000	10.566.000	1.727.000	14
3	11.100.000	4.414.000	6.686.000	60
4	18.376.500	14.600.000	3.776.500	21
5	10.597.000	6.810.000	3.787.000	36
6	8.002.000	6.400.000	1.602.000	20
7	7.061.500	4.588.000	2.473.500	35
8	19.145.500	16.000.000	3.145.500	16
9	11.471.500	8.240.000	3.231.500	28
10	6.258.000	-	-	-
11	3.452.000	290.000 €	3.162.000	92
Average	*11.423.500*	*8.653.500*	*2.770.000*	*34*

*Without remediation and preparation costs

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