Evaluación de los Costes y de la Planificación en Rehabilitaciones de Bloques de Vivienda. Evaluation of the Costs and Planning in Residential Block Renovation Projects

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Resumen—Tras la crisis económica del año 2008, con gran impacto en el sector inmobiliario, la rehabilitación de viviendas se potenció como modelo urbanístico frente a la ciudad expansiva y de salida de la crisis. Por ello, este trabajo tiene por objetivo analizar la viabilidad económica del proceso de rehabilitación en España, en concreto a través de casos seleccionados de bloques de viviendas rehabilitados en la Comunidad Autónoma de Aragón. La metodología de estudio analiza los diferentes costes que incurren en el proyecto, las ayudas públicas recibidas para la rehabilitación y los flujos de caja que se originan, contrastándolo con los plazos de ejecución de todo el proceso. Este estudio establece estimaciones económicas y temporales para futuros análisis de viabilidad. Además, para poder optar a otras vías complementarias de financiación, mediante la incorporación del sector privado, el estudio fija las necesidades económicas y márgenes de beneficio o perdida.

Palabras clave: Rehabilitación viviendas; viabilidad económica; modelo gestión; crisis económica; vivienda social

Abstract—After the 2008 economic crisis, which had a great impact on the real estate sector, housing renovation was promoted as an urban development model in contrast to the urban sprawl and as a means of overcoming the crisis. As such, this paper seeks to analyze the economic feasibility of the renovation process in selected examples of renovated residential blocks in Spain, specifically in the region of Aragon. The study methodology analyzes the different costs incurred in the project, the government grants received for renovation and the cash flows that are generated, contrasting them with the completion times for the whole process. This study establishes economic and time estimates for future feasibility analyses. In addition, in order to be eligible for additional financing routes, by including the private sector, the study sets out the financial needs and profit or loss margins.

Index Terms— Housing renovation, economic feasibility; management model; economic crisis; social housing

I. INTRODUCTION

THE conservation and regeneration of established city neighborhoods, particularly the most rundown areas, by means of the renovation of its housing, is one of the aspects generating the most interest amongst the government's objectives, as is apparent in Housing Plans and Renovation Strategies. These actions are also driven by an increase in social awareness concerning the reduction of architectural barriers in existing buildings and by sustainability criteria. Sustainability criteria must firstly be understood as a comfort requirement for people and, secondly, as a need to reduce energy consumption during the property's lifetime.

Housing and services buildings, the latter including shops, offices and equipment, account for 40% of the European Union's total final energy consumption. It is necessary to reduce this consumption and thereby lessen the environmental impact of such buildings. It is anticipated that energy consumption will continue to increase in Spain because of the growing demand for energy which is required to cope with increasingly high and unremitting temperatures.

It is for this reason that, in Spain, housing renovation increased as a means of activating the construction sector after the 2008 economic crisis, thereby changing the paradigm of construction in the face of the halt in new construction whilst seeking a new model to make the sector more sustainable. In this regard, at the National Environmental Conference, the experts reached the conclusion that it is necessary to renovate 400,000 properties a year in order to achieve the 2050 objective (CONAMA10, 2010); likewise, after 2013, Housing Plans were more focused on this objective.

A market subsequently opened up with ample opportunities, but, in turn, significant deficiencies. Various studies analyze the issues with the building stock requiring renovation. Others reflect the intrinsic obsolescence of aspects of their construction, which is also identified in some of the cases included in the present study (Kurtz et al., 2015). These and other examples have been analyzed from a sustainable renovation management standpoint, this having been dealt with more extensively by other authors (Ruíz Palomeque, 2015; Rubio de Val, 2015; Guajardo, 2016), and by devising good practices to be used in projects implemented in obsolete neighborhoods (García Vázquez, C. et Al. 2016).

The technical need, that associated with the accessibility and sustainability of building renovation, results in a requirement for funding for the project implementation, this only being feasible if there are government grants. In this respect, there are existing studies which are of enormous interest in the R+D+i sector, generating numerous projects, such as:

- The study: "Evaluation of the building costs and energy consumption derived from the energy rating of properties" (PRECOST&TE, 2022), which focuses upon the impact which the energy rating has on the implementation cost of a building, and evaluates the financial investment involved in implementing the construction measures required to improve the energy rating (García-Navarro et al., 2014),
- The project: "Sustainable Building Renovation" (2022) which sets out a comprehensive system for the sustainable renovation of existing buildings, so as to improve their energy efficiency and
- The project: "NEWsolutions4OLDhousing" (2022) which proposes the implementation of innovative technologies to combat climate change, fostering the efficient use of resources and energy in building restoration.

A. Objective

This paper seeks to evaluate selected examples of renovated residential blocks in Spain, specifically projects implemented in the region of Aragon, which may be used to establish attractive scenarios by way of business cases so as to boost public-private collaboration in this kind of project.

This primary objective may be broken down into the following specific objectives:

- Analysis of the renovation planning for the cases studied.
- Analysis of the economic environment of the economic development which can be used for future implementation estimates.
- Cash flow simulations.
- Detection of the financial risks which hinder actions.

I. METHODOLOGY

The economic feasibility of the projects is confirmed using specific examples of residential block renovations in the region of Aragon, analyzing the duration and cost scenarios, making it possible to quantify an economic framework per property after the renovation work. This economic framework shall form the basis of the cash flow analysis related to the implementation, accounting for both the total cost and the income obtained through grants. Furthermore, the analysis is performed with a future private collaboration in mind, delegating the renovation to a private company which takes on projects to generate revenue. The research is carried out in four phases:

A. Selection and definition of the case studies.

This phase involves compiling information concerning real cases of residential block renovation, in which the scope of the work carried out and the building systems used respected the original structure wherever possible. These projects involved residential blocks built between 1945 and 1965, where individual properties measure between 45m^2 and 70m^2 and had the following construction features:

- 4-5 story buildings without elevators
- uninsulated façades
- Inadequate external woodwork
- Obsolescence of improved construction due to a lack of maintenance over time and
- Health issues due to damp in the external enclosures
- The renovation work was carried out between 2006 and 2017

The cases selected for study span different economic periods in Spain: a time of strong economic growth such as the

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year 2006, a time of severe crisis such as 2012 and 2013 and a time of economic recovery such as the year 2015, as shown in Table 1.

The routes used to obtain the data were:

- Interviews with the architects behind the projects, presidents of the residents' associations, estate administrators, construction companies and local government technical staff.

TABLE I
CASE STUDIES

CASE	Nº PROP.	STORIES	LOCATION	YEAR OF RENOVATION WORKS
1	40	B + 4	Zaragoza	2009-2010
2	28	B + 4	Zaragoza	2009-2010
3	8	B + 3	Zaragoza	2009-2010
4	9	B + 4	Zaragoza	2010-2011
5	88	B + 3	Huesca	2010-2012
6	8	B + 3	Zaragoza	2011
7	16	B + 3	Zaragoza	2013-2014
8	20	B + 5	Sabiñánigo (Huesca)	2015-2016
9	40	B + 4	Zaragoza	2014-2016
10	24	B + 3	Zaragoza	2016
11	24	B + 3	Zaragoza	2016

- Reviewing the construction projects and administrative records in the town's archives.

B. Analysis of the duration of the renovation work

This section involves a review of the implementation times for the renovation process in each case. The start date for the work is determined from the analyses and preliminary reports concerning the state of the building and the need to undertake renovation work. The process continues with the drafting of the plans and the subsequent application for and issuing of the building permits and ends with the implementation of the work itself. The study concludes when the last of the government grants for the renovation work is obtained, this being after the construction is completed.

This section of the study is directly related to the economic analysis.

C. Economic analysis

On the one hand, the study of the cases from an economic point of view involves researching the expenditure required in order to undertake the renovation, and, on the other hand, ascertaining the revenue that will be obtained. Since the aim of such projects is not to sell a product so as to obtain an economic result, the income side includes the different government grants and subsidies the work may benefit from. The cost breakdown methodology used by other authors has been adapted (Ruíz Palomeque et al., 2006).

The different economic packages which affect a renovation project have been divided as follows:

- Initial costs

- Building costs
- Financial costs
- Income

D. Initial costs

The initial costs encompass those costs which are incurred at the start of the project, serving as the driving force behind it. Worth mentions: the reports from technical building inspections and technical reports in the event of a building pathology. Those costs which are compulsory or advisable are also considered, such as a geotechnical study or topographic survey.
These costs imply the payment of compulsory levies, namely VAT (value-added tax).

E. Building costs

These involve the largest amounts of the project life cycle. The building costs are divided into the following costs:

F. Technical costs

The technical costs are the fees associated with the drafting of the construction plan, along with the necessary installation plans and the health and safety report for the construction sites. They encompass costs associated with site management, collaborating organizations of the administration (OCA) and technical control bodies (OCT).

G. Administrative costs

The administrative costs are derived from the cost of issuing the building permit.

H. Building costs

This cost encompasses all of the expenditure required to implement the construction work and complete it in accordance with the conditions set out in the construction plan. The cost analyzed is the cost of carrying out the renovation, broken down into phases by the construction company that first bid for the contract and then carried out the work. This cost is that which generates the highest cash flow.

I. Tax costs

This section includes the tax costs attributed to the added value of the work (VAT), this being a tax which the property owners must pay with no right to deduction.

J. Financial costs

The residents' associations are required to have the necessary funds to be able to make the project payments, primarily during the months that the work is being carried out. In order to be able to meet the different payments, the residents' association must have sufficient liquidity. Each owner may pay the money for the work directly, however, this is not a common formula in these cases. As such the study contemplates the possibility of taking out a loan from a banking entity in order to be able to carry out the entire project.

K. Income

The concept of income includes grants to promote renovation, which are provided for in the different housing plans. Such grants come from local or regional government.
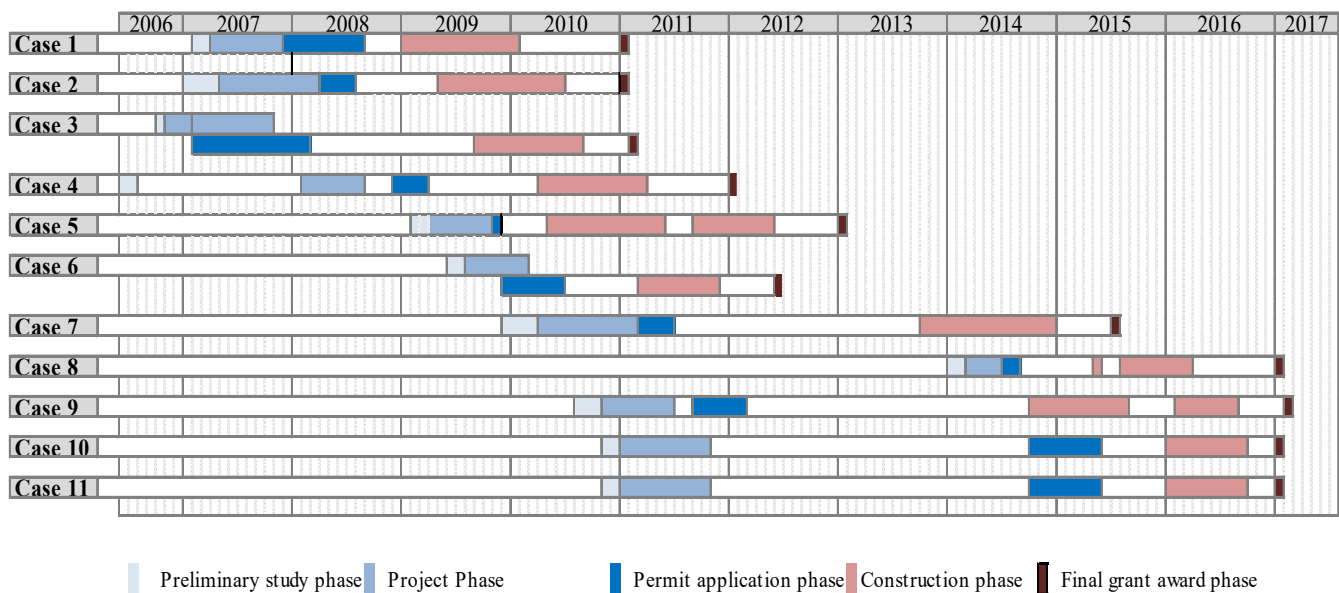
Preliminary study phase ■ Project Phase   ■ Permit application phase ■ Construction phase ■ Final grant award phase
Fig. 1. Renovation process plan for the specific cases

L.   Cash flow analysis. Economic feasibility study

Using the data, related to both the temporary scenario of each of the activities making up the renovation process, and to the costs and revenue involved at each stage, a monthly cash flow study is carried out for each case, with a view to obtaining the investment project analysis by following the usual economic methodologies (Martínez Abascal, 2005).

Finally, using the cash flow and having obtained the revenue and expenditure data for every stage of the project, a dynamic feasibility study is performed.

II.   RESULTS AND DISCUSSION

This section details the results obtained in relation to the objectives outlined and the methodology followed.

A. Study of the duration of the renovation process

With regard to the first planning section, a study has been carried out looking at the lifecycle of the measures implemented, from their inception through to their execution and completion. The measures have been set out in chronological order in Figure 1 according to the year in which they were implemented, and separated into different phases (preliminary studies, plan drafting, permit application, construction, final grant award).

The lifecycle comes to an end on completion when the last payment of the final grant is received. This milestone coincides with the last monthly payment of the regional government grant, following the completion of the work (it is having been estimated during the study).

It can be observed in the figure that there is practically no activity in the lifecycles of the cases studied during the years 2012 and 2013. During the process of defining the case studies, no data fulfilling the conditions was obtained for this period in the region. These years coincided with the toughest periods of the economic crisis, the planning being representative of and

aligned with the economic situation of that time. Government grants for renovation work were not excluded from the impact of the crisis, and even residents' associations themselves were also subsidiary victims of the situation.

It is noted that, in most cases there is a protracted period of time between the permit being granted and the start of the renovation work. This time, which should normally coincide with the period of contract negotiation for the work and may start during the permit application phase, usually exceeds seven months, some cases exceeding twelve months and two cases reaching twenty-seven and thirty-one months respectively.

The reasons given by the different parties involved (residents' association presidents, real estate administrators and drafting team) include the degree of uncertainty amongst the property owners in relation to obtaining government grants, the amount of these grants and the period of time during which a decision about the application will be made. Residents' associations apply for renovation grants in response to the announcements made by the different regional governments, these focusing on specific periods of time although the final decision ends up taking a significant time.

No data was obtained about cases in which the renovation work was not subsequently carried out, although the level of risk of not completing the project considerably increases during this period, mainly due to causes unrelated to the residents' association. Another time limiting factor is the building permit application process, for which average periods of eight months have been calculated.

Table 2 contains a summary of the different cases studied, grouped by the number of properties with the averages obtained for the durations of certain variables. These time periods serve as a reference for estimates of future work. This table shows that to improve performance the project drafting period should be reduced along with the period between the permit being awarded and the work commencing.

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TABLE II
EXECUTIVE SUMMARY OF TIME PERIODS BY GROUPS

	GROUPS <10 Properties				GROUPS 40 Properties		
	Case 3	Case 4	Case 6	average	Case 1	Case 9	average
Nº Properties	8	9	8	8	40	40	40
Entire process duration (months)	47	58	30	45	36	73	55
Renovation work duration (months)	12	12	9	11	13	18	16
Time permit-start of work (months)	18	12	8	13	4	31	18
Permit application (months)	13	4	7	8	9	6	8

	GROUPS 15-30 Properties						>80 Prop.
	Case 2	Case 7	Case 8	Case 10	Case 11	average	Case 5
Nº Properties	28	16	20	24	24	22	88
Entire process duration (months)	42	61	27	70	70	54	40
Renovation work duration (months)	14	15	9	9	9	11	22
Time permit-start of work (months)	9	27	8	7	7	12	5
Permit application (months)	4	4	2	8	8	5	1

B. Study of implementation costs

Since it is the property owners themselves who are responsible for meeting the costs, the cost of implementing the work is analyzed based on the cost per property. Furthermore, the grants and subsidies for renovation work are awarded per property. As such, this parameter shall be adopted for the study.

In most cases, the largest amount is devoted to improving efficiency. It is also noteworthy that, in some cases (cases 1, 7, 9, 10 and 11), owners take advantage of the renovation work to implement other improvements which have a significant economic impact on the overall budget, without this situation resulting in a disproportionate increase in the final cost of the work.

The total cost is that which should be taken into consideration so as to enable each property owner to assess their financing needs and decide how they are going to be able to manage. In the two projects carried out in the province of Huesca (cases 5 and 8), the cost of the work per property (an average of 18,014€ per property) is half of that invested in the province of Zaragoza (where the average cost per project is 39,122€ per property). Although it is difficult to isolate and analyze these differences in any depth, they are due to the reduced scope of the installation section and to the period when the work was commissioned (better price at a time of severe crisis) in addition to the pronounced geographical differentiation in terms of economic aspects between the two provinces (the province of Huesca is cheaper than that of Zaragoza).

These differentiated values between cases are within the same economic ranges of cost per property in relation to the comparative data from property renovation cost studies from six European countries (Web, 2018), there being the same differences between countries as those detected between projects in the cases studied.

Where implementation costs are concerned, the average and median values are established for the cases, validating them against a three-point estimate following a beta distribution, in accordance with the formula [1], this being considered a proven technique for cost estimation in line with the PMBOK Guide (GFDP, 2021):

$$[1] \quad \beta = (cO + 4cM + cP) / 6$$

Where cO is the optimistic cost, cM is the most probable cost and cP is the most pessimistic cost. Using this formula, we calculate the estimated range of the work and the standard deviation according to the formula [2]

$$[2] \quad \sigma = (cP - cO) / 6$$

TABLE III
COST SUMMARY AND BREAKDOWNS

	GROUPS <10 Properties				GROUPS 40 Properties		
	Case 3	Case 4	Case 6	average	Case 1	Case 9	average
Nº Properties	8	9	8	8	40	40	40
Entire process duration (months)	47	58	30	45	36	73	55
Renovation work duration (months)	12	12	9	11	13	18	16
Time permit-start of work (months)	18	12	8	13	4	31	18
Permit application (months)	13	4	7	8	9	6	8
Cost of Work (CO)	387,551,.05	537,396,.11	382,212,.33	435,719,.83	1,518,588,.63	1,370,489,.20	1,444,538,.92
Total Project Cost (CT)	504,669,.75	699,905,.33	500,277,.50	568,284,.19	1,932,951,.01	1,785,353,.91	1,859,152,.46
Cost per property based on CO	48,443,.88	59,710,.68	47,776,.54	51,977,.03	37,964,.72	34,262,.23	36,113,.47
Cost per property based on CT	63,083,.72	77,767,.26	62,534,.69	67,795,.22	48,323,.78	44,633,.85	46,478,.81

| | GROUPS 15-30 Properties | | | | | | >80 Prop |
	Case 2	Case 7	Case 8	Case 10	Case 11	average	Case 5
Nº Properties	28	16	20	24	24	22	88
Entire process duration (months)	42	61	27	70	70	54	40
Renovation work duration (months)	14	15	9	9	9	11	22
Time permit-start of work (months)	9	27	8	7	7	12	5
Permit application (months)	4	4	2	8	8	5	1
Cost of Work (CO)	1,284,454,.89	613,365,.95	355,097,.53	600,182,.91	613,505,.30	693,321	1,608,120,.94
Total Project Cost (CT)	1,639,844,.72	812,253,.57	480,313,.90	787,089,51	803,966,.10	904,694	2,024,824,.04
Cost per property based on CO	45,873,.39	38,335,.37	17,754,.88	25,007,.62	25,562,.72	30,507	18,274,.10
Cost per property based on CT	58,565,.88	50,765,.85	24,015,.70	32,795,.40	33,498,.59	39,928	23,009,.36

Table 3 displays the data obtained. It contains the total project cost, the total cost of the work, and the cost of the work broken down into general sections (according to the project type).

These averages obtained by both arithmetic and three-point estimation, may be adopted for initial project estimates and for process feasibility analysis.

When analyzing the monthly certifications data for the work by property, differences are observed between the cases. These differences vary depending on the duration of the work and the type of renovation. They are more pronounced in cases of renovation in buildings containing less than ten properties, where there are larger spikes in the monthly certifications. In cases of between fifteen and thirty properties, there is greater linearity, and in the case of blocks containing more than forty properties, there is no similarity between them.

In the latter case, there is also an unusual factor in that for case 9 the work was implemented in two phases, with little time between them, but this resulted in the existence of more liquidity peaks from the first phase and a period with zero costs, without possibility of validation.

Those cases where there is constant evolution in the certifications have been separated. Uniformity in the amounts is observed in six of the eleven cases studied, in which the duration of the work is more similar (between eleven and fourteen months, case 10 standing out with a duration of nine months). Figure 2 shows this linear tendency for the isolated cases, which would be between 3000€ and 5000€ per month and property requiring certification for two thirds of the work. In the initial months, there is a growing linear tendency in the certifications.

This data shall serve as a reference in feasibility studies for future projects to estimate cash flow with greater certainty as well as cash needs in the implementation phase.

C. Economic feasibility study

Following the plan set out in figure 1, the cash flows have been calculated as shown in table 4, in order to analyze the economic feasibility. The cash flow is used to obtain the differences between expenditure and revenue, as well as the profit margin (differential between revenue and expenditure).

The differences between the margins are justified by the percentage of aid received in each case, thereby penalizing the end result. Figure 3 shows the margins for each case along with the trend. In cases 1 to 3 and even in cases 7 and 11 the margin is not far from 0%. A margin of -25% is adopted as the average result to be applied to future feasibility studies.
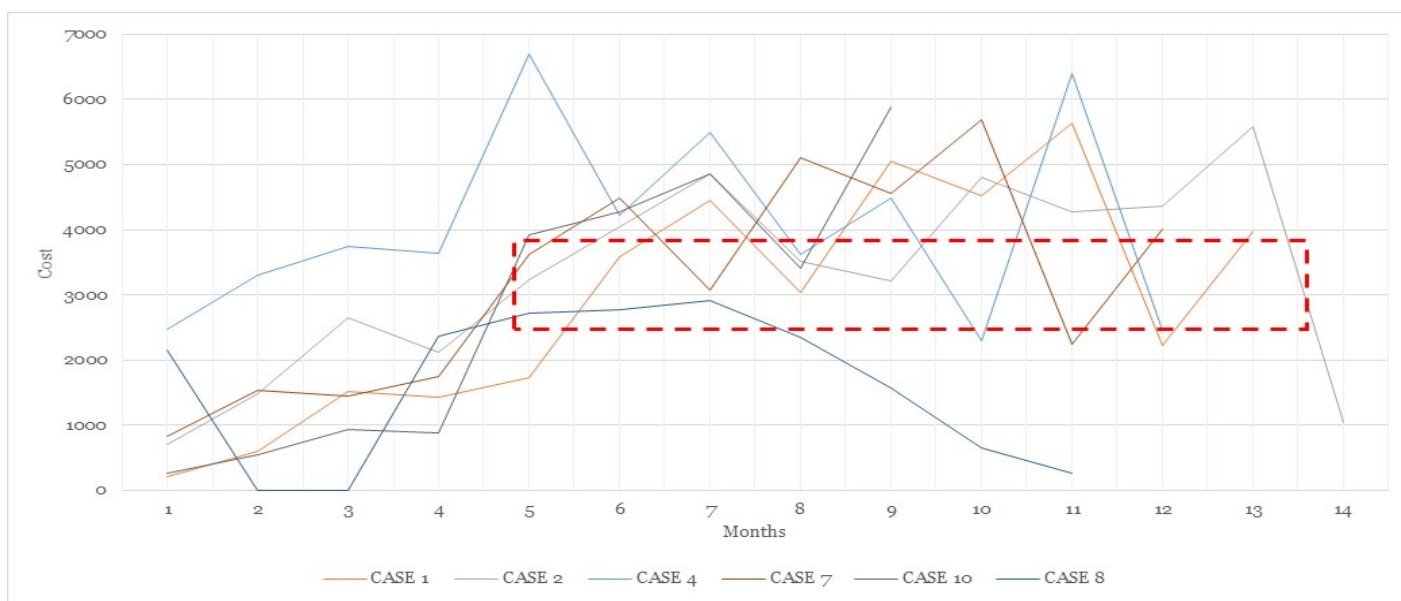

Fig. 2. Monthly certifications per property by groups.

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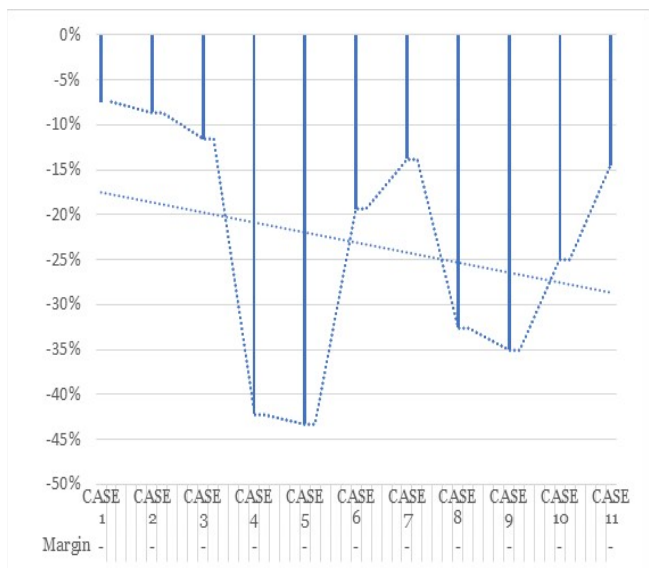Evaluation of the Costs and Planning in Residential Block Renovation Projects

Fig. 3. Margin trend line

Peaks and troughs are observed in the cash flow which have a notable impact on the different projects (figure 4). The peaks represent the payment of the government grants and the troughs represent the costs, some of them being very pronounced due to coinciding with a month of significant building activity and as such, payments associated with the work carried out. A positive result or even a zero result is not achieved during the implementation cycle, a positive impact peak finally being reached on receipt of the final grant payment. Neither is numeric similarity achieved since there is no analogy in the distribution of the flow for the different cases, although the different projects gradually display peaks and troughs depending on the revenue and expenditure.

As expected, the results from calculating the NPV and the MIRR are negative, as may be seen in table 5.

TABLE IV
SUMMARY OF EXPENDITURE AND REVENUE STREAMS

	Expenditure (€)	Revenue €	Difference	Margin
Case 1	-1,932,951.07	1,788,000.00	-144,951.07	-7.50%
Case 2	-1,639,844.72	1,498,335.34	-141,509.38	-8.63%
Case 3	-504,669.75	446,138.56	-58,531.19	-11.60%
Case 4	-699,905.33	404,311.32	-295,594.01	-42.23%
Case 5	-2.024,824.04	1.148,525.66	-876,298.38	-43.28%
Case 6	-500,277.50	403,294.48	-96,983.02	-19.39%
Case 7	-812,253.57	700,244.40	-112,009.17	-13.79%
Case 8	-480,313.90	323,893.00	-156,420.90	-32.57%
Case 9	-1,785,353.91	1,159,810.47	-625,543.44	-35.04%
Case 10	-787,089.51	589,812.82	-197,276.69	-25.06%
Case 11	-803,966.10	687,233.21	-116,732.89	-14.52%

TABLE V
NPV AND MIRR RESULTS

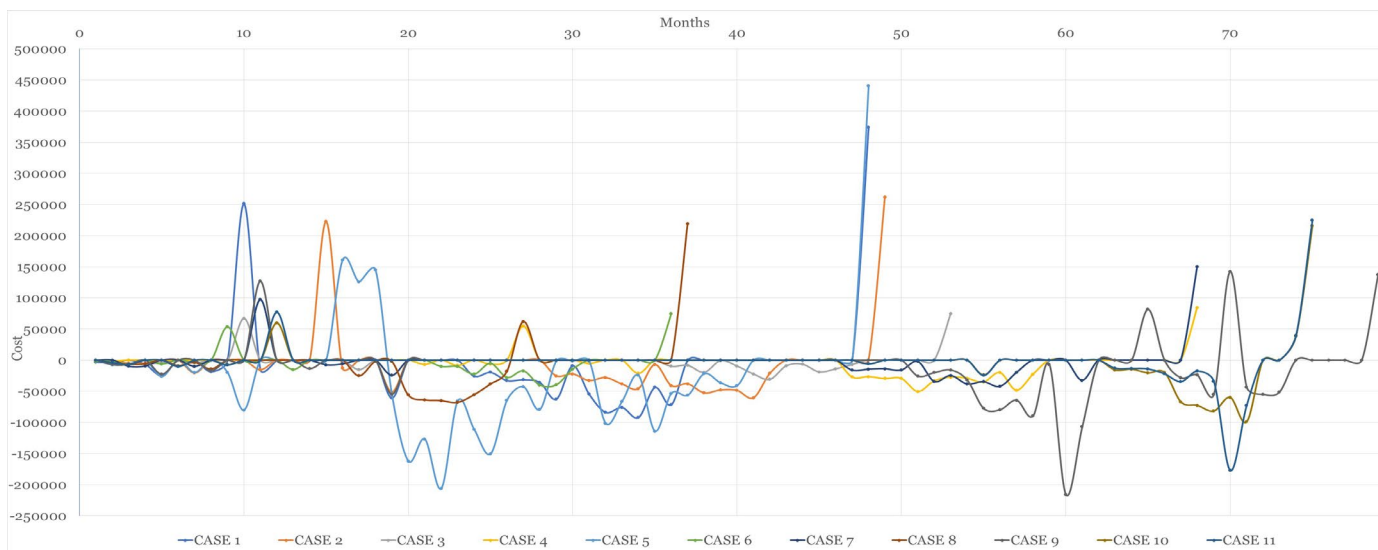|	NPV (€)	MIRR
Case 1	-142,192.16	-0.25%
Case 2	-129,904.67	-0.34%
Case 3	-49,373.54	-1.70%
Case 4	-264,373.71	-1.53%
Case 5	-836,028.26	-1.28%
Case 6	-155,180.52	-1.40%
Case 7	-204,850.76	-0.35%
Case 8	-163,885.00	-1.16%
Case 9	-500,417.40	-0.87%
Case 10	-149,471.60	-0.53%
Case 11	-84,055.30	-0.25%

Fig. 4. Evolution of cash flows

III. CONCLUSIONS

The research establishes cost and duration scenarios for projects such as those studied, as may be deduced from the results in the tables produced, these being adopted as estimates when analyzing the total costs and durations required for a similar renovation project. It also provides knowledge of the true financing needs, ensuring that property owners do not need to refinance based on inaccurate preliminary economic estimates.

With the aim of achieving economically feasible projects, the total duration of the process must be reduced, this being directly related to the feasibility and closing balance for the purposes of financing and changes of cycle. On the other hand, agile decision making by the property owners prevents the incurring of costs derived from situations linked to changes of economic cycle such as tax modifications, as occurred in cases 3-4, 7, 9-11. This factor has been identified as one of the greatest project risks.

This study confirms the need to streamline renovation project implementation periods to determine the economic feasibility of projects. To this end, the following measures shall be applied:

- Property: achieving faster decisions and consensus to reduce the time between completing the implementation plan and/or obtaining the construction permit and starting the work.
- Drafting team: reduction in the project implementation times, optimization of construction solutions.
- Administration: agility in processing construction permit applications. Faster grant award rulings and payments in parallel with the generation of costs (payments associated with preliminary reports, plans, permits, site management and certification of works).

Having clear estimates of the total costs which are to be generated along with being able to rely on the timely payment of grants, precisely when payments are due, directly reduces the property owners' need for external funding, thereby also reducing project costs. As such, there is better control of the cash flow.

In terms of future feasibility, analyzing the profit or loss margin of the cases studied using cash flow requires further projects to be explored. The construction solutions adopted must enable the issues with the building to be resolved whilst maintaining the prescribed characteristics and without increasing the allocated implementation costs. Finally, the income must be increased to recover the percentage of economic losses generated and obtain positive results.

The generation of new projects must contribute added value for both the property owners and, indirectly, for society itself, with the difficulties that this involves, as seen in completed studies proposing new options for revenue (18-20). Such projects should be linked to mechanisms which enable the incorporation of private companies, to make the process feasible, even obtaining a return on exploitation, without the property owners losing the grants which are so necessary for undertaking the project.

REFERENCES

CONAMA10 (2010). *Informe del Congreso Nacional de Medio Ambiente.* Recuperado de http://www.conama10.vsf.es/download/bancorecursos/Informe%20Conama%2010.pdf . Madrid, España

Kurtz, F., Monzón, M. López-Mesa, B. (2015). Obsolescencia energética y acústica de la vivienda social de la postguerra española en áreas urbanas vulnerables. El caso de Zaragoza. *Informes de la construcción*, 67 (EXTRA-1): m021, doi: http://dx.doi.org/10.3989/ic.140062

Ruiz Palomeque, G. (2015). Gestión de la rehabilitación sostenible en Grandes Conjuntos de las periferias urbanas por las administraciones públicas locales. *Informes de la construcción, 67 (EXTRA-1)*:m025, doi: http://dx.doi.org/10.3989/ic.14047

Rubio de Val, J(2015) Potencial del nuevo marco normativo para el impulso de la rehabilitación y la regeneración urbana en los ámbitos autonómico y local. *Informes de la construcción, 67 (EXTRA-1)*:m025, doi: http://dx.doi.org/10.3989/ic.14072

Guajardo, A. (2016). Análisis tipológico de bloques lineales de vivienda social: España 1950-1983. El caso de Andalucía occidental. *Informes de la Construcción, 69*(545): e185, doi: http://dx.doi.org/10.3989/ic.16.055.

García Vázquez, C. et Al. (2016) "Intervención en Barriadas Residenciales Obsoletas. Manual de Buenas prácticas". *Abada Editores*

Proyecto *PRECOS&TE*, recuperado de https://blogs.upm.es/gisci/es/precoste/

García-Navarro, J., González-Díaz, M.J., Valdivieso, M. (2014). «Estudio Precost&e»: evaluación de los costes constructivos y consumos energéticos derivados de la calificación energética en un edificio de viviendas situado en Madrid. *Informes de la Construcción, 66(535)*: e026, doi: http://dx.doi.org/10.3989/ic.13.052.

Proyecto *Rehabilitación Sostenible de Edificios,* Recuperado de https://blogs.upm.es/gisci/es/sostenibilidad-y-eficiencia-energetica-en-edificacion/

Proyecto *NEWsolutions4OLDhousing,* recuperado de http://www.newsolutions4oldhousing.eu/index.php?lang=es

Jiménez Romera, Carlos; Molina Costa, Patricia y Nicolás Buxens, Olatz (2017), "Procedimientos innovadores de gestión y financiación en actuaciones de rehabilitación y regeneración urbana". *Ciudades*, 20, pp. 89-110 doi: 10.24197/ciudades.20.2017.22

Falcón Pérez, Carmen Esther; Fuentes Perdomo, Juana (2017). "La participación de las cooperativas en el desarrollo urbano sostenible". *En REVESCO. Revista de Estudios Cooperativos, nº125, Pp.89-108.* ISSN: 1885-8031 http://dx.doi.org/10.5209/ REVE.57063

Fajardo García, G. et al. (2014). "Las cooperativas de vivienda en la Comunidad Valenciana. Constitución y funcionamiento". *CIRIEC España, Valencia* ISBN: 978-84-941260-6-2

Ruíz Palomeque, G./Rubio de Val, J. Nuevas propuestas de rehabilitación urbana de Zaragoza. *Estudio de conjuntos urbanos de interés.* Zaragoza Vivienda, 2006

Martínez Abascal, E. (2005). *Finanzas para directivos.* Análisis de proyectos de inversión (p.p. 135-165). Madrid. McGraw-Hill

29

Evaluación de los Costes y de la Planificación en Rehabilitaciones de Bloques de Vivienda.
Evaluation of the Costs and Planning in Residential Block Renovation Projects

The Financing of Renovation in the social Housing sector. A comparative study in 6 European countries (2018), Recuperado de http://www.housingeurope.eu/resource-1124/the-financing-of-renovation-in-the-social-housing-sector. Brussels. (2017).

Guía de los fundamentos para la Dirección de Proyectos. Guía del PMBOK, 7ª Edición. Gestión de los Costos del Proyecto - Estimar los costos (p.p. 244-245). Pennsylvania. EEUU. Project Management Institute.

Rubio de Val, Juan (2013), "La rehabilitación integral de algunos conjuntos urbanos de Zaragoza. Una oportunidad para el reciclado sostenible de ciudad". Revista Aragonesa de Administración Pública. Pp.27-72 ISSN: 1133-4797

Grau Rutz, María Amparo (2017). "La oportunidad del estímulo fiscal a la eficiencia energética en la rehabilitación de inmuebles para lograr la sostenibilidad de la vivienda". CIRIEC-España. Revista Jurídica Nº 31/2017.

Rosa Jiménez, Carlos J.; Márquez Ballesteros, Maria Jose; Navas Carrillo, Daniel (2017). "Hacia un nuevo modelo de gestión y autofinanciación de la regeneración de barriadas obsoletas". Ciudades, 20, Pp. 45-70. DOI:10.24197/ciudades.20.2017.26