

What are the economic and temporal consequences of the use of overtime in construction?

Gonzalo José Francisco Pérez-Gómez-Martínez, Facundo Cortés-Martínez, Areli Magdiel López-Montelongo, Claudia Melissa Guerrero-Cháirez

Abstract— The purpose of this research was to define the economic convenience of using overtime within the building processes, when these are considered in a planned and programmed manner, but without leaving aside its impact on wages and the health of workers. The methodology followed in the study was with the filling of a questionnaire by professionals of the work, this information was used for the analysis of descriptive statistics, correlation, and factor analysis. The results found showed that the extended working hours under the considerations established for the study did not reduce the amount of the sale price to the owner, although the increase was marginal, so the impact on profits was discreet, but the reduction in Construction time is remarkable, mainly to avoid the impact of unforeseen events, since indirect costs are significantly reduced. From the work it is concluded that working overtime should always be a decision that is not required by the builder because it generates losses. Now, if it is properly planned, it will not be a risk or loss factor, and the reduction of the construction time can bring benefits to those involved.

Index Terms—Construction industry, Economic impact, Overtime, Workforce.

I. INTRODUCTION

The use of overtime in the building is frequently linked to a forced situation, which usually causes economic losses to the builder. Overtime becomes one of the largest running costs of a work, but it can also be the cause of costly lawsuits and low staff morale [1]. Furthermore, the psychosocial aspects of this measure are decisive for generating a feeling of well-being since voluntary overtime is better accepted than required [2]. For this reason, the administration must adequately plan the additional day, since otherwise, these costs are dragged towards construction prices [3].

It must be borne in mind that the human resource in

Gonzalo José Francisco Pérez-Gómez-Martínez, Sustainable Viability of the Building, Autonomous University of Coahuila/ School of Architecture/ Academic Body, Torreón, Coahuila, México, +52-871-720-2083/ +52-871-735-3146.

Facundo Cortés-Martínez, Modeling and Technological Development, Juarez University of the State of Durango/ Faculty of Engineering, Sciences and Architecture/ Academic Body, Gómez Palacio, Durango, México, +52-871-715-2017/ +52-871-221-0984.

Areli Magdiel López-Montelongo, Sustainable Viability of the Building, Autonomous University of Coahuila/ School of Architecture/ Academic Body, Torreón, Coahuila, México, +52-871-720-2083/ +52-871-240-0959.

Cháirez, Student, Autonomous University of Coahuila/ School of Architecture/ Torreón, Coahuila, México, +52-871-720-2083/ +52-871-221-4510.

construction is the factor that dictates, based on its capacity and application, what development the process must have [4]. But it is also very true that in construction the human factor lacks formal preparation, learning takes place with experience, which makes it slow, it is understood then that the sector requires a cultural change to increase the commitment to people, seeking training is the best investment a construction company can make, so this process should no longer be occasional [5]. Another aspect with respect to labor is their health, since the working conditions and the work environment favor the appearance of certain diseases, which are triggered by aspects of the worker such as their economic, socio-cultural or lifestyle condition [6].

It is estimated that the success of a construction is referred to the achievement of three basic objectives, adjusting the expenses to the budget, finishing within the programmed period, and reaching the promised quality [7]. However, projects are always faced with innumerable situations that make it difficult to meet costs and times, thus errors in the organization, planning, changes to the design, the environment of the work among others can be highlighted [8]. Consequently, a delay in the work implies an extension of the support infrastructure and its expenses, and if these are not managed effectively, they will add a significant cost to what has already been budgeted [9]. For the construction client, costs are the decisive factor for their investment, so efficient and effective planning of these is essential for the success of the project, especially in estimating the first stages of construction [10].

The use of overtime allows the amount of indirect costs to be reduced, since their expenses are in relation to the duration of the work. It is understood that indirect costs do not directly intervene in the development of the work but are essential for its proper functioning [11]. In addition, it is considered that the compression of the process does not increase the cost of physical work, and if it can influence the reduction of indirect costs [12]. And undoubtedly market pressures are currently forcing construction companies to reduce their costs and increase the value of their product [13].

II. METHODOLOGY

For the development of the study, it was considered to apply a questionnaire to construction professionals, these would be approached in person to ensure that all questions were answered. The surveyed builders were basically architects or civil engineers with experience in various areas of the building industry, so that their responses were representative of the sector. The format presented would consist of ten main questions, which would include 100 related

What are the economic and temporal consequences of the use of overtime in construction?

items, all having a numerical weighting from 0 to 10, being important to ensure that no response had been omitted, to use all the questionnaires. The basic questions that would be raised are the following:

1. Given the possibility of using overtime, should the Federal Labor Law be considered?
2. what will be the impact of overtime on the health of workers?
3. Do working conditions impact staff performance?
4. Aspects on which the capacity of the workforce depends?
5. level of impact of direct costs on the definition of the sale price?
6. level of impact of indirect costs in the definition of the sale price?
7. level of impact of the sale price on the profitability of the construction company?
8. At what level does the availability of resources determine the time of the work?
9. At what level does the management of the equipment determine the time of the work?
10. At what level does the management of the construction process determine the time of the work?

First, a pilot test of the questionnaire application would be carried out, to determine its validity through the calculation of Cronbach's Alpha, for which the IBM SPSS program will be used. Once the reliability of the instrument has been verified, the universe of questionnaires to be applied will be defined, for which the respective mathematical function is used. With the results obtained from the questionnaires, the statistical analysis of said information will be carried out. To carry out this work, the STATISTICA program will be used, with which values can be calculated and defined, so that interpretations, inferences, and conclusions can be generated in relation to the problem studied. The program will allow the concepts related to:

1. Descriptive statistics of signa lists
2. Descriptive statistics of the questionnaires
3. Correlation between questions
4. Factor analysis

Finally, an economic analysis will be carried out of the impact that the occupation of overtime has on the profits of a construction. For this purpose, the occupation of one, two and three masonry crews will be considered, working from one to six extra hours per week, with the understanding that the drop in staff performance will be considered [14], and the legal considerations for the payment of the extended day [15]. The application of such considerations will be on the construction of a residential project, in the city of Torreón, Coahuila, Mexico. Said work will have an area of 500 square meters, a construction period of 50 weeks, cost per square meter built 15,000.00 Mexican pesos, a sale price of 7'500,000.00 and an expected profit of 690,000.00. Regarding this last data, it is expected to see the impact of overtime, in relation to the decrease in work time and its consequence on indirect costs. This last aspect constitutes the main objective of the investigation.

III. RESULTS

In the first place, the reliability of the instrument had to be

determined to obtain field information, this was achieved through the calculation of Cronbach's Alpha, using the IBM SPSS program. The results obtained after carrying out the pilot test showed that the questionnaire was reliable, and therefore could be applied. These conclusions are shown in table I.

Table I: Pilot test questionnaires

Valid cases	15 Mean	8.751
Cases excluded	0 Minimum value	6.800
# Of elements	100 Maximum value	9.800
Cronbach's alpha	0.938 Rank	3.000
Cronbach's alpha,	Standard	
standardized elements	0.951 deviation	0.609

Source: Self made

Once the reliability of the questionnaire instrument was assured, the number of these that would be required for the investigation was determined. Considering that construction professionals registered within the respective colleges of both architects and civil engineers in the study area were approached, the known population was determined in 220 subjects, the confidence level was established in 94%, by what the percentage of error was situated in 6%. With the use of these data, the calculation of the number of questionnaires to apply was set at 116.

In the sense of accurately determining which aspects of the use of overtime in construction were of greatest relevance to construction professionals, and with the intention that the calculation be reliable, the option taken was using the program STATISTIC. It was possible to determine for the applied questionnaires, concepts used in descriptive statistics, such as the definition of centrality measures (mean, median, mode), and of dispersion measures (variance, standard deviation, statistical bias, kurtosis, coefficient of variation, Z value). Below and in Table II, the main results obtained from the descriptive statistics for the questionnaires are highlighted, and which refers to the importance conferred by the professionals of the work.

Table II: Descriptive statistics questionnaires

#	Item	\bar{X}	σ	Negative skew	Variation Kurtosis	Z coefficient	Z value
Question 10: Impact of the management of the work in the time of this							
92	Planning work aspects	9.37	1.15	-3.29	15.47	12.31	8.12
91	Efficient work program	9.37	1.10	-2.82	11.09	11.73	8.52
93	Internal coordination	9.25	1.07	-3.11	17.31	11.57	8.64
99	Resource availability	9.12	1.45	-3.34	15.86	15.85	6.31
Question 4: Manpower capacity							
26	Staff experience	9.19	1.63	-2.91	10.36	17.75	5.64
34	Supervision communication	9.02	1.62	-3.33	15.47	17.91	5.58
Question 7: Impact of the profitability of the construction company on the sale price							
56	Quality and sale price	9.21	1.33	-2.45	8.02	14.43	6.93
61	Competent company	9.09	1.38	-2.74	10.78	15.14	6.61

Source: Self made

The data analyzed in this way allowed to establish at the beginning, the importance that the concepts, actions and activities questioned have for the constructors, and in this way to verify the normality of the curve, and therefore its degree of predictability in attention to homogeneity. who presented the data? After calculating the descriptive statistics, the definition of the correlation between the most significant questions for

the general objective and the hypothesis of the study was carried out, this allowed us to know which items move in parallel, and which in an inverse way, with reference to the value of 0.238285, found to establish whether or not there is a correlation, to be able to highlight the most important connections in light of the need or intention to integrate overtime in the work. Information presented in table III.

Table III: Correlation between questions

Value	Correlation
	Questions 1 and 2: Overtime, Labor Law, occupational health
0.38	To the extent that wages observe the Labor Law for overtime, more attention is paid to the age of the worker, to preserve occupational health.
-0.16	To the extent that overtime does not respond to a compelling reason, the number of hours worked goes against occupational health.
	Questions 3 and 4: Labor performance, working conditions
0.43	The correct crew favors the capacity of the personnel, and the more compliance that can be achieved with the working conditions, the better the performance of these will be.
-0.08	The performance of the staff benefited by the working conditions does not pay for them to have a better understanding of the graphic information necessary for the development of the work.
	Questions 5 and 6: Direct costs, indirect costs, sales price
0.58	Timely availability of supplies favors work times, and the definition of the percentage in this sense is more precise.
0.55	The more consideration there is of the characteristics of the work, the better the integration of wages.
	Questions 5 and 10: Direct costs, sale price, time of the work
0.58	The timely availability of inputs favors the definition of subcontracts to be more appropriate for the sale price.
0.52	The study of personnel logistics favors work times, and allows the integration of salaries to be more precise.
	Questions 6 and 10: Indirect costs, sale price, time of the work
0.51	The better internal coordination exists in the work, the calculation of indirect costs will be more appropriate.
0.48	The more the conditions dictated by the location of the work are taken into account, the better the aspects of the process can be planned.

Source: Self made

The correlation showed that the items considered in the questionnaire are to a greater or lesser degree interdependent, which allows making decisions that are more direct and correct, in the sense of the integration of overtime in the work. The next step was to carry out the factor analysis, to establish that the instrument used with the constructors could explain the phenomenon studied, using the STATISTICA program again, the number of underlying factors in the problem was determined, and the percentage of interpretation they offer with respect to the scheduled application of overtime in construction. The results for the eigenvalues are shown in table IV.

Table IV: Eigen values

#	Eigen value	Accumulated
1	27.30235	27.30235
2	4.62843	31.93078
3	4.06285	35.99363
4	3.67269	39.66632
5	3.15676	42.82308
6	2.98'	
...		79.4761
26	1.02127	79.49737

Source: Self made

From the calculation carried out on the eigenvalues, the existence of 26 factors was determined, which can explain up to 79.49737% of the problems studied within the work, which

allowed a broad understanding of the phenomenon under investigation. A more in-depth analysis was carried out on the first 5 factors, since among these they are the most representative and with them a cumulative percentage of 42.82308 was reached. The main inferences of these factors are presented in table V, in relation to their value and to that of Pearson's r found of 0.238285.

Table V: Factorial analysis

# item	Factor	Value	Item description
79	3	0.837732	Timely supply of overtime supplies
63	2	0.805168	Continuous improvement according to processes
80	3	0.796269	Logistics study of internal movements
2	4	0.768253	Previous definition amount of overtime
75	5	0.762261	Work warehouse efficiency in overtime
93	1	0.758514	Adequate internal coordination on site
76	5	0.753951	Central warehouse efficiency in overtime
95	1	0.748831	Adequate coordination of subcontractors
64	2	0.741808	Continuous improvement company commitment

Source: Self made

The concepts highlighted by the calculation of the descriptive statistics, the correlation between the questions and the factorial analysis allow to establish clear criteria for the development of the work in overtime, so that this need does not imply a substantial economic loss to the budgeted profits of a work, and that allows the builder to consider all the aspects that in the face of an unforeseen request from the client, will not cause losses to the company or damage to the personnel. Even before the definition of all these aspects, a calculation was carried out as anticipated on the impact of the extended working day, on the profits of the construction of a residence. The summary of this information is presented in table VI.

Table VI: Economic impact overtime

Groups (288 hours per week)	Extra hours	Total hours per week	Real hours week	Total work weeks	Profit loss amount	Profit loss percentage
1	1	289	288.97	49.83	2622.40	0.38
	2	290	289.94	49.66	5143.75	0.75
	3	291	290.91	49.49	7564.06	1.10
	4	292	291.88	49.33	9883.33	1.43
	5	293	292.85	49.16	12101.56	1.75
	6	294	293.82	48.99	14218.75	2.06
2	2	290	289.94	49.66	5143.75	0.75
	4	292	291.88	49.33	9883.33	1.43
	6	294	293.82	48.99	14218.75	2.06
	8	296	295.76	48.65	18150.00	2.63
	10	298	297.70	48.32	21677.08	3.14
	12	300	299.64	47.98	24800.00	3.59
3	3	291	290.91	49.49	7564.06	1.10
	6	294	293.82	48.99	14218.75	2.06
	9	297	296.73	48.48	19964.06	2.89
	12	300	299.64	47.98	24800.00	3.59
	15	303	302.55	47.47	28726.56	4.16
	18	306	305.46	46.97	31743.75	4.60

Source: Self made

The economic analysis in the case presented shows that overtime will always have a negative impact on profits, although this occurs quite marginally, unlike the compression suffered by work times, which is much more significant, since

What are the economic and temporal consequences of the use of overtime in construction?

The shorter the process lasts, the less exposed the builder is to the effects of unforeseen events that may arise, and that may also affect profits, so a consensual and programmed decision on the use of the extended working day on the job it may be of benefit to the parties.

IV. DISCUSSION

The Doloï study establishes that profitability requires an early estimation of costs [16]. This work also highlights the relevance of labor for direct costs. Soliz Baldovinos highlights the importance of indirect costs in the survival of a construction company [17]. This research adds that the reduction of work time due to overtime brings economic benefits due to the reduction of indirect ones. The document by Becker, Jaselskis & El-Gafy maintains that indirect costs can reach up to 40% of the amount of this [13]. On the contrary, the current study shows that indirect payments can be reduced by up to 2%, for each week in advance. The research by Llovera, Bautista, Llovera and Alfaro indicates that breaks during working hours avoid irregular rhythms [18]. This paper adds that the profitability of the company depends on job security. Attia, Duquenne & Le-Lann support labor modulation as the means to negotiate working hours [19]. In the current research it is added that a better impact of the personnel will be given if there is a study of the logistics of their needs and movements.

Mayorga's work defines that subcontracting and staff rotation require having defined processes [20]. With the current work, it is added that there must also be an adequate program and effective internal communication. Bhutto establishes that overtime damages the personal work-life relationship, but that it is tolerated because of the salary gain [21]. The present research on the other hand highlights that workers are not very concerned about sacrificing their leisure time for monetary reward. Kim & Kim's work states that, given the uncertainty of current projects, better management is necessary [22]. In the current document, efficient coordination with subcontractors is also established as very relevant. For their part, Kazaz, Ulubeyli, Acikara & Er affirm that 50% to 70% of the work time is devoted to activities that do not add value [23]. The present work adds that the best way to fulfill the time commitment is with the strict observance of the work schedule. Radhakrishnan, Selvan & Kumar establish that a good construction strategy is to have a cordial relationship between the builder, personnel, subcontractors, and suppliers [24]. The current document adds that to achieve this, adequate communication channels must be established.

From Globerson's work, it can be deduced that the extension of the work time requires the continuity of general support [9]. The present study adds that the precision of the program slims the indirect ones. For Visser, overtime must be authorized before being executed, since it constitutes an extra expense [1]. The current work adds that in the extended working hours the consideration of labor laws is mandatory. Long & Arroyo's research shows that Lean principles are a factor in increasing productivity [25]. With this study it is added that continuous improvement is only effective if it

constitutes a commitment of the entire company. Singh & Delhi believe that the planning of the workspace helps to meet the objectives [26]. From the current work, the study of the logistics of both the process and the movements of the personnel is defined, as necessary. Lastly, Vela Moreno argues that overtime reduces staff performance, but this is minimized with an adequate selection of activities [14]. In the current investigation, it is added that to develop extended-time work, how many hours will be worked must be previously defined? Its true salary impact and be paid according to what the law indicates.

V. CONCLUSION

Due to what is exposed in this research, overtime in the building does not manage to reduce the amount of the sale price of a construction that can be offered to a client, although it can be assured that the impact on profits is marginal, in relation to compression of the original program. In addition, the decrease in work time on the other hand if it is significant, since this reduction avoids the possibility of action of unforeseen events, accidents to workers and possible increases in all inputs. Consequently, the extended workday will bear good results if it is agreed between the parties involved, programmed, and analyzed in a comprehensive manner. Therefore, overtime should never be the answer without an adequate prior review, the recovery of the scheduled times, or some advance requested unexpectedly.

It is estimated that if overtime is duly agreed, planned, programmed, and considering all its legal implications, towards the health and performance of the personnel, not only will they not be a loss, but they can also bring important benefits to the parties. Generally, as the analysis of the antecedents and the theoretical framework demonstrated, the extended workday appears unexpectedly, which has negative consequences of all kinds, which increase costs. But when these situations are considered in advance, they are eliminated, and indirect costs were found to considerably reduce their impact. Finally, the key points to consider for the integration of overtime as a strategy in the work are highlighted below:

1. Effective communication
2. Construction management
3. Indirect costs
4. The logistics of the process
5. The work program
6. Availability of machinery
7. Occupational health
8. Continuous improvement
9. The profitability of the construction company
10. Direct costs
11. Labor

ACKNOWLEDGMENT

Thanks to the Juárez University of the State of Durango, for the possibility and the intellectual support received, to carry out this research. As well as to the Autonomous University of Coahuila, for the support to carry out the research stay in Colombia.

REFERENCES

- [1] A. Visser, "How to manage overtime" *Finweek*. ISSN 1812-4658. South Africa, 2017, pp. 44-45. Available: <http://web.a.ebscohost.com/>.
- [2] M. Watanabe, K. Yamauchi, "Psychosocial factors of overtime work in relation to work-nonwork balance: A multilevel structural equation modeling analysis of nurses working in hospitals" *International Journal of Behavioral Medicine*. ISSN 1070-5503. Japan, 2016, pp. 492-500, vol. 23, num. 4. Available: <http://web.b.ebscohost.com/>.
- [3] P. Evans, "Building industry braces for changes" *Grand Rapids Business Journal*. ISSN 1045-4055. United States, 2016, pp. 3-7, vol. 34, num. 26. Available: <http://web.b.ebscohost.com/>.
- [4] J. G. Prince-Ríos, "Impacto de la mano de obra sobre los procesos constructivos de la vivienda social, en Torreón, Coahuila" *Bachelor's Thesis, U.A. de C. Mexico*, 2018. "unpublished".
- [5] K. Waseca Love, "Construction sector should invest more in people" *Journal of Business*. ISSN 1075-6124. United States, 2018, pp. 7-16, vol. 33. Available: <http://web.b.ebscohost.com/>.
- [6] J. A. Villarreal, M. Puebla-Rodríguez, R. Fonseca-González, E. B. Álvarez-Rivero, "La tríada salud-trabajo-ambiente y su impacto en los trabajadores" *Revista Salud de los Trabajadores*. ISSN 1315-0138. Cuba, 2017, pp. 147-155, vol. 25, num. 2. Available: <http://redalyc.org/>.
- [7] M. Juszczyk, A. Lesniak, "Modelling construction site cost index based on neural network ensembles" *Academic Search Complete*. ISSN 2073-8994. Poland, 2019, pp. 411-415, vol. 11. Available: <http://web.a.ebscohost.com/>.
- [8] S. López-Serna, I. Patiño-Galindo, A. Gómez-Cabrera, A. Torres, "Identificación de factores que generan diferencias de tiempo y costos en proyectos de construcción en Colombia" *Revista Ingeniería y Ciencia*. ISSN 2256-4314. Colombia, 2018, pp. 117-151, vol. 14, num. 27. Available: <http://web.a.ebscohost.com/>.
- [9] S. Globerson, "Using the earned value approach for controlling overhead cost in construction projects" *Journal of Modern Project Management*. ISSN 2317-3963. Israel, 2017, pp. 50-55. Available: <http://web.b.ebscohost.com/>.
- [10] L. Zaho, J. Mbachu, L. Domingo, "Exploratory Factors Influencing Building Development Costs in New Zealand" *Buildings*. ISSN 2075-5309. New Zealand, 2017, pp. 1-16, vol. 7, num 3. Available: <http://web.b.ebscohost.com/>.
- [11] O. A. Fontalvo-Ochoa, "Costos De Construcción Y Su Aplicación Óptima En Los Ejercicios De La Ingeniería Civil En Colombia" *Artículo, Universidad de Santo Tomas*. Colombia, 2017, pp. 1-10. Available: <http://repository.usta.edu.co/>.
- [12] R. Zaini, S. Hidayat, A. A. Santosa, "Management Analysis of Construction Acceleration of Library Building" *European Researcher Journal*. ISSN 2219-8229. Indonesia, 2017, pp. 329-338. Available: <http://web.b.ebscohost.com/>.
- [13] T. Becker, E. Jaselskis, M. El-Gafy, "Improving predictability of construction project outcomes through intentional management of indirect construction costs" *Journal of Construction Engineering and Management*. ISSN 1943-7862. United States, 2014, pp. 1-7, vol. 140, num. 6. Available: <https://ascelibrary.org/>.
- [14] V. B. Vela Moreno, "Estudio de las horas extraordinarias en la mano de obra de la construcción de la Comarca Lagunera de México" *Master's Thesis. U.A. de C. Mexico*, 2019. "unpublished".
- [15] Chamber of Deputies, "Federal Labor Law", Mexico, 2015. Available: <http://www.diputados.gob.mx/>.
- [16] H. Doloi, "Cost overruns and failure in project management: Understanding the roles of key stakeholders in construction projects" *Journal of Construction Engineering & Management*. ISSN 0733-9364. Australia, 2013, pp. 267-279, vol. 139, num. 3. Available: <http://web.b.ebscohost.com/>.
- [17] I. Soliz Baldovinos, "Costos indirectos en la construcción" *Bachelor's Thesis, UNAM*. Mexico, 2013. Available: <https://s3.amazonaws.com/>.
- [18] S. Llovera, J. Bautista, J. Llovera, R. Alfaro, "Tiempo efectivo de trabajo: Un análisis normativo de la jornada laboral en el sector de automoción" *Scientific-Technical Document, UPC*. Spain, 2014. Available: <http://upcommons.upc.edu/>.
- [19] E. A. Attia, P. Duquenne, J. M. Le-Lann, "Considering skills evolutions in multi-skilled workforce allocation with flexible working hours" *International Journal of Production Research*. ISSN 0020-7543. France, 2014, pp. 4548-4573, vol. 52, num. 15. Available: <http://web.a.ebscohost.com/>.
- [20] M. Mayorga, "Medición de la productividad en la mano de obra en el sector de la construcción, en el distrito metropolitano de Quito" *Bachelor's Thesis, PUCQ*. Ecuador, 2014. Available: <http://repositorio.puce.edu.ec/>.
- [21] R. Bhutto, "Extended work overtime: Labors' (employees) choice or obligation" *South Asian Journal of Management Sciences*. ISSN 2074-2967. Pakistan, 2015, pp. 63-68, vol. 9, num. 2. Available: <http://web.a.ebscohost.com/>.
- [22] T. Kim, Y. W. Kim, "Activity-based costing for process improvements" [24th Annual Conference of the International Group for Lean Construction United States, 2016, pp. 53-62]. Available: <https://iglcstorage.blob.core.windows.net/>.
- [23] A. Kazaz, S. Ulubeyli, T. Acikara, B. Er, "Factors affecting labor productivity: Perspectives of craft workers" [Creative Construction Conference Turkey, 2016, pp. 28-34]. Available: <https://ac.els-cdn.com/>.
- [24] S. Radhakrishnan, K. G. Selvan, S. Kumar, "Reasons for spiraling costs in construction industry" *International Journal of Multidisciplinary Approach & Studies*. ISSN 2348-537X. India, 2017, pp. 8-14, vol. 4, num. 2. Available: <http://web.a.ebscohost.com/>.
- [25] D. Long, P. Arroyo, "Language, Moods, and Improving Project Performance" [26th Annual Conference of the International Group for Lean Construction India, 2018, pp. 495-504]. Available: <https://iglcstorage.blob.core.windows.net/>.
- [26] A. R. Singh, V. S. K. Delhi, "Site Layout Planning Waste, Typology, and it is Handling Through Ar-Bim Concept: A Lean Approach" [26th Annual Conference of the International Group for Lean Construction India, 2018, pp. 123-133]. Available: <https://iglcstorage.blob.core.windows.net/>.



Pérez-Gómez-Martínez, Gonzalo José Francisco. Master of Science in Civil Engineering, PhD student in Civil Engineering Sciences, professor-researcher, 28 publications, 17 research projects.



Cortés-Martínez, Facundo. Doctor in Engineering, author of articles and books on sanitation, optimization and mathematical models, professor-researcher.



López Montelongo, Areli Magdiel. PhD in Architecture, Author of articles on environmental design, Full-time research professor.



Guerrero-Cháirez, Claudia Melissa. Student-Thesis of the degree in architecture, published article on time efficiency in construction.