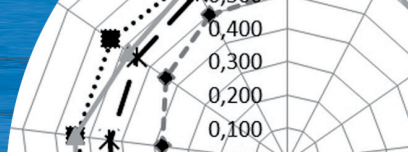

Towards a methodology for assessing the Human Development Index in the Chilean construction industry

Hacia una metodología para evaluar el Índice de Desarrollo Humano en la industria de la construcción chilena

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Eric Forcael[1], Vicente González[2], Francisco Orozco[3], Alexander Opazo[1], Sergio Vargas[1] y Angelo Sandoval[1]

[1] Department of Civil and Environmental Engineering, Universidad del Bío-Bío, 1202 Collao Avenue, Concepción, Chile, eforcael@ubiobio.cl, aopazove@ubiobio.cl, svargas@ubiobio.cl, angsando@alumnos.ubiobio.cl
[2] Department of Civil and Environmental Engineering, The University of Auckland, Private Bag 92019, Auckland Mail Centre, Auckland 1142, New Zealand, v.gonzalez@auckland.ac.nz
[3] Department of Civil Engineering and Management, Universidad Panamericana, Guadalajara Campus, Calzada Circunvalación Poniente #49, Ciudad Granja, Zapopan, Jalisco, México, forozco@up.edu.mx

The Human Development Index HDI is a summarized quantification of human development of nations, based on three dimensions: income, education and health, classifying countries differently to the Gross National Income GNI index classification. However, for the construction industry, the authors found no plausible evidence of exhaustive studies in this sector, from the standpoint of the HDI. Thus, the present study seeks to provide a methodology to calculate the HDI for workers in the construction industry by using Chile as a case study. In this study, it was found that the HDI in construction varies geographically with the variation in the income dimension, but not with respect to education or health dimensions. These results for the construction sector were then compared with the conventional HDI, finding differences. This would confirm that workers in construction differ from workers in other sectors.

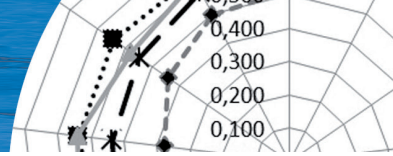
Keywords: HDI, human development, manpower, construction industry, Chile

El Índice de Desarrollo Humano IDH es una cuantificación resumida del desarrollo humano de las naciones, basado en tres dimensiones: ingreso, educación y salud, que clasifica a los países de forma distinta a la entregada por el Producto Interno Bruto PIB. Sin embargo, para la industria de la construcción, los autores no encontraron evidencia plausible de estudios exhaustivos en este sector, desde el punto de vista del IDH. Así, el presente estudio busca proveer una metodología para calcular el IDH para trabajadores en la industria de la construcción, usando a Chile como caso de estudio. En este estudio, se encontró que el IDH en la construcción varía geográficamente con la variación de la dimensión ingreso, pero no en relación a las dimensiones educación o salud. Estos resultados para el sector de la construcción fueron luego comparados con el IDH convencional, encontrando diferencias. Esto confirmaría que los trabajadores en la construcción se diferencian de los trabajadores de otros sectores.

Palabras clave: IDH, desarrollo humano, mano de obra, industria de la construcción, Chile

Introduction

For years, the study of the countries' development has been one of the main objectives for the economy. However, the focus has not always been on the person, taking into account only factors related to income level and growth over time (Edo, 2002). On the other hand, economic growth neglects the increased capabilities of a country's people and their influence on improving the welfare and development of said country. It is important to consider that the real wealth of a nation is its people (UNDP, 1990), making the need to broaden the concept of development for the human transcendental. Current alternatives that account



for this human factor and its development have emerged exactly for this reason. While many feel that economic prosperity is the only way to a fulfilling life, many other factors, like better education and health services, have become important too (Sen, 1997). This concept was first introduced through a Human Development Index HDI elaborated by Mahbubul Haq, who based his work on ideas from Amartya Sen (winner of the Nobel Prize in Economics in 1998). This index measures the level of human development of a country, covering three essential levels: health, education, and standard of living (UNDP, 2010), where each dimension is represented by a sub-index based on data coming from diverse institutions.

Annually, the United Nations Development Programme UNDP presents HDI world reports for each country in study, allowing them to compare their situation to others'. This has led the international search for new ways to measure the human development, furthering the notion that economic growth does not automatically bring a better quality of life (Haq, 1995). When comparing a particular country's HDI with its Gross National Product GNP per-capita, cases show situations of high levels of human development with low incomes, as well as low levels of human development with high incomes (UNDP, 1990). Paradoxically, education and healthcare have been shown to lead to greater development worldwide, not incomes necessarily.

In recent years, several human development reports have been conducted at national, regional and local levels in many countries, identifying the levels of development within each country, and providing information that policymakers can use to propose specific solutions in the most needed areas of their countries. In order to promote the growth of the capabilities of individuals within other fields, this research proposes calculating the Human Development Index for the construction industry, using Chile as a case study. Thus, this paper aims to study the workforce in construction.

In Chile, as in the world, the construction industry is a major generator of jobs, and contributes significantly to the development of economy, ranked fourth as the highest source of jobs (NENE, 2012). In this sense, it is interesting to assess the level of human development for these people, considering that some of the factors that characterize these workers are the level of physical exertion, in addition to the constant accident risks, which they are exposed to. Also, the level of education of construction workers is low or even none in many cases. In contrast to the previous factors, a significant percentage of these people earn good incomes (CChC, 2011). Therefore, those key dimensions of the HDI (Income, Education, and Health) will be calculated and analyzed for construction workers in Chile.

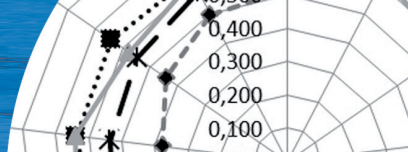
Research objectives

The main objective of this research is to calculate the Human Development Index for workers of construction, considering Chile as a case study. This main objective consists of two specific objectives: 1) to identify and gather the data for the construction workers used to calculate the HDI, without modifying the structure and concept of human development, and 2) to evaluate differences in human development for workers of the construction sector, in different regions of the country.

Literature review

As mentioned, economic development has been for a long time the main objective when evaluating the performance of actions taken within a country. However, the fact of associating the development of a country exclusively to its level of economic growth has been criticized, because the income cannot be the only target for people (Griffin, 2001). From this perspective, Sen (1983) states that the most important shortcoming of traditional economic development is to focus only on the national product, aggregate income and total supply of particular goods, instead of rights and capabilities of people. Thus, economic development should take into account what people can or cannot do, *e.g.*, if they can live long, be well nourished, be able to communicate, participate in literary and scientific works, *etc*. Accordingly, a new concept emerges focused on people growth, called Human Development, by which individuals' expectations expand, such as: a long and healthy life, education, and a decent standard of living (UNDP, 1990).

The Human Development Index HDI (Haq, 1995) is created with the purpose of determining a number, which has the same level of simplicity as the GNP, but without disregarding the social aspects of human lives (UNDP, 1999a; Haq, 2003). Assessment of human development



through the HDI considers three essential elements: 1) life expectancy at birth, 2) years of schooling, and 3) levels of decent living (UNDP, 1990), where each dimension is represented by a sub-index based on data universally available. Longevity and education are related to the training of human capabilities, and income is a measure of the opportunities when a person utilizes her/his capabilities (UNDP, 1990). The basis of the HDI has remained constant in all reports published to date on global human development; however, the methodology of calculation of each sub-index and the data used, has changed in order to better represent each country. Also, Haq (1995) notices that the options of people are multiple and they cannot all be quantified and measured, so any index should include a limited number of simplified and manageable variables.

The information provided in global reports and published yearly by the UNDP, considers a number of important aspects, with the aim of achieving a better human development assessment. HDI results obtained for each country are ranked to know the differences between countries and to visualize progresses or setbacks, defining strategic actions and opportunities for improvement and overcoming poverty across the nations (UNDP, 1990, 1991, 1992, 1997). According to Haq (1995), reports have greatly influenced the global search for reaching development, noting that the HDI is a mirror for all societies, helping authorities to see how people live in order to propose solutions.

One of the most important features of the HDI is its simplicity, because with a single value it is possible to know the status and trends about the human development in different countries. Other important feature is its universality, because it includes relevant aspects about industrialization, facilitating comparisons between nations (Booysen, 2002). It is also considered a flexible instrument, able to measure differences and changes over time in human development between countries (Griffin, 2001). Additionally, the HDI has opened new perspectives about development, assuming a new approach by measuring the range of options available to a person (Kelley, 1991). Despite the human development is much deeper and complex than any information captured by an index, it is needed to count on a simple measuring tool; the HDI meets that condition (Torres and Allepuz, 2009).

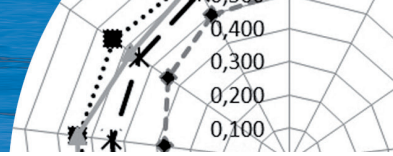
Methodology

This research focuses on the Chilean construction industry, specifically on people who make up the workforce of the sector, in order to study them from the point of view of human development. The research methodology considers the following steps: 1) to review the conventional HDI calculations and to adapt them to the construction workforce; 2) to collect data from Chilean public institutions to calculate the HDI; 3) to calculate the HDI for labour in the construction industry for different geographical areas of Chile; and 4) to statistically analyze the results to determine significant differences between regions.

Conventional HDI in Chile

To date, hundreds of global and regional human development reports have been issued in 140 countries (UNDP, 2011). In Latin America a significant number of reports have been published, enabling an important systematization of national human development analysis (Pol, 2007). Since 1996, UNDP has conducted several human development analyses of the Chilean society, through the preparation of national and regional reports. Chile is geographically divided into 15 regions, where each region is divided into cities. In this country, a model based on the political distribution of regions and municipalities has been implemented and presented in a report, providing a detailed analysis of human development within regions (UNDP - MIDEPLAN, 2000; UNDP, 2006).

In Chile, the HDI is defined by the Potential Years of Life Lost PYLL for the health dimension; by the adult literacy, average schooling and educational coverage for the education dimension; and by the average per capita income of households, the average per capita income adjusted for household poverty, and the average per capita income of households corrected by the Gini coefficient for the income dimension. Despite this approach is much more demanding, the conceptual basis of conventional HDI remains (UNDP - MIDEPLAN, 2006). The HDI has been widely accepted in Chile, used in the academic and Non-Governmental Organizations NGO sectors; in public administration (ministries, services); in entities related to the management of local development (regional governments, municipalities); in the political level;



and in the media for discussion and planning (UNDP, 1999b). Several contributions are attributed to the human development reports made in Chile, producing a large impact on the academic elite and politicians, generating discussion and being a driving factor in the debate on the national situation, especially in the field of work in public policy (Ramos and Acosta, 2006).

HDI for the Chilean construction industry

The construction industry is traditionally intensive in the use of labour (Rivas *et al*., 2011). In this context, job performance plays a key role in the success of a project (Liu and Ballard, 2008). Also, some authors suggest that the labour costs represent between 30 and 50% of the total project cost (Hanna 2001; Harmon and Cole, 2006). In addition, the labour is considered one of the components of greatest risk within a project (Hanna, 2001). However, despite the great attention paid to the economic impact of labour on construction projects, a wider analysis that considers such important issues as education, health and income, has not been taken into account.

Regarding education, CPWR (2009) mentions that Hispanic construction workers typically have less educational level than non-Hispanic workers. Half of Hispanic construction workers have less than a high school diploma, compared with non-Hispanic workers. Several authors state that the construction sector provides employment to those with little education or skill, many of them from the poorest sectors of society (ILO, 2001, de Souza, 2000). In terms of health, the International Labour Organization (ILO, 2001) mentions that not only the safety of the job is an area of concern, but also the healthcare of construction workers. For income approach, salaries are relatively high in some regions of Chile, according to CChC (2011). Despite studies of human development focus on people, these studies have not been intensively applied to specific populations. For this reason, this paper seeks to calculate the Human Development Index for workers in the construction industry by using Chile as a case study.

Field study

At this stage, a search for a large variety of information was collected from entities linked to the construction sector, which satisfy the conceptual requirements for calculating the conventional HDI. The data needed to calculate the HDI, defined and limited to workers in the construction industry, were: income per capita; years of schooling; expected years of schooling; life expectancy; potential years of life lost; registration of deaths by age; number of fatal accidents by age and economic sector. In order to obtain the data needed national entities were defined and then contacted (telephone, email, videoconference). The following are the entities contacted: Superintendence of Social Security; Chilean Chamber of Construction; Chilean Safety Association; Mutual Safety Society; Regional Secretary of Health; National Statistics Institute.

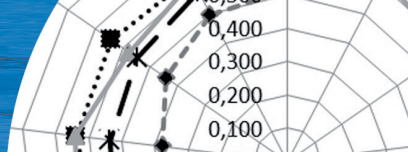
Despite the limited information available in Chile related to the construction workers, it was possible to find the information needed for this research as follows. From the Socioeconomic Study of Construction Workers elaborated by the Chilean Chamber of Construction (CChC, 2011), which assumes an average working experience (from trainee to senior workers), the following information was obtained: (1) percentage of workers in the construction sector, by region, by specialty, by ranges of Take Home Pay or Net Wages received, by educational level (years of schooling), and by personal perception of workers' healthcare; (2) number of household members; (3) distribution of workers surveyed by specialty and geographic region. From the Superintendence of Social Security, the following was the information collected: (4) accident statistics database; and (5) monthly average number of construction workers who paid the insurance for occupational accidents and diseases (mandatory by law).

Calculation of the HDI for the construction industry

As mentioned, the methodology to calculate the HDI was adapted for the construction workers; however, it was built on the conceptual basis of the conventional HDI. Therefore, although the results here obtained are not directly comparable in absolute terms, they are in relative terms, for example, by creating rankings that allow prioritize geographical areas in function on their HDI.

Organization of collected data

According to the information collected, the following variables were used to calculate the HDI:



• *Income dimension*: per-capita income, used in UNDP (2011) and the UNDP - MIDEPLAN (2006).

• *Education dimension*: average years of schooling according to UNDP (2011) and the UNDP - MIDEPLAN (2006).

• *Health dimension*: it is defined by two variables: (a) rate of Potential Years of Life Lost PYLL, according to the UNDP (2006) and; (b) percentage of workers who answer very good and good to the question How would you say is your overall health?, used by the UNDP-MIDEPLAN -University of La Frontera (2003).

According to the Department of Epidemiology of the Ministry of Health of Chile (MINSAL, 2012), the PYLL corresponds to a synthetic indicator representing the impact of premature mortality on a population, and assumes that a death occurring earlier than expected provokes a loss of potential life years, where the younger the person who dies, the greater the magnitude of that loss potential. In this case, the PYLL considers deaths occurred by accidents in the construction sector only.

a) Setting data used

Because net salary and educational level data were broken down, it was necessary to define a value for each dimension by region. In the case of net income or take home pay data (which were classified into ranges), a regional average was calculated according to (1) and the methodology to calculate the mean for data grouped in classes described by Levin and Rubin (1998).

$$\bar{x} = \sum_{i=1}^{i=n} \frac{f_i x_i}{n} \quad (1)$$

Where $\bar{x}$ is an average regional salary; f_i is the frequency (number of observations) of each class; x_i is the midpoint of each class; n is the total number of observations in the region, and i is each class. The income dimension required the per-capita income as a variable, obtained by dividing the regional average and the average household members of each region. The calculation of per-capita income nationally was determined as shown in (2).

$$\bar{x} = \frac{\sum s_i n_i}{\sum g_i n_i} \quad (2)$$

Where $\bar{x}$ is the national average wage, s_i is the regional average wage, n_i is the number of observations in the region i and g_i is the average household members number in the region i.

In the case of education data, the average was determined based on the accumulated years of schooling, according to: (a) elementary and middle school: 8 years; (b) high school: 4 years; (c) technical: 2 years (educational institutions offer technical programs at an average of 2 years); (d) university: 5 years (higher education institutions offer programs at an average of 5 years). The data of schooling were considered ungrouped data, calculating regional averages as the mean from ungrouped data described by Levin and Rubin (1998), which is conceptually equivalent to (1), where $\bar{x}$ is the value in years of each educational level. The average years of national schooling were determined as shown in (3).

$$\bar{x} = \frac{\sum a_i n_i}{N} \quad (3)$$

Where $\bar{x}$ is average years of national schooling; a_i is average years of schooling in the region i; n_i is the number of observations in the region i and N is the total number of observations. To determine the rate of PYLL, the methodology described by MINSAL (2012) was used:

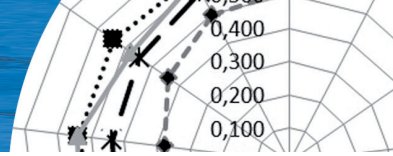
• The limit of potential life of the Chilean population is 80 years.

• The PYLL is obtained by subtracting the potential limit of life (80 years) and the age at death (which is weighted by the number of deaths in the age interval).

• Finally, PYLL rate is calculated according to expression (4).

$$Rate_{PYLL} = \frac{PYLL}{Total\ \ population} 100 \quad (4)$$

Where total population corresponds to the monthly average number of construction workers, who paid their social insurance. According to the variable percentage of workers who answered very good and good to the question how would you say is your health in general?, variable used for the Health Dimension of the HDI, the value of the percentage was used without adjustments because it is a value ranging between 0 and 1 (0% and 100% respectively).



b) Determination of maximum and minimum values

For the calculation of the HDI, minimum and maximum values have to be determined (limit values), in order to transform the indicators into indices, with values between 0 and 1 (UNDP, 2011). The limit values for the income dimension were determined based on the percentage of construction workers (by region, by specialty and take home pay ranges), and the averages of the respective household members for each specialty. For the upper limit, the highest ranges of salary and the lowest average of the corresponding household members were considered, obtaining the most favourable scenario for the per-capita income, and for the lower limit, the lowest salary ranges and the highest average household members were considered, obtaining the most unfavourable situation. For the education dimension, the no schooling and the maximum number of years in the college/university level were considered, and for the variable PYLL rate, needed for the health dimension, the average of the best and worst decile was used.

HDI calculation at the national and regional level

With the prepared data for each region and country, the next step was to calculate the regional and national HDI, according to the general methodology used in UNDP (2013). This consists of two steps: 1) to calculate the index for the dimensions income and education, based on the average net salary, years of schooling, and the considering their maximum and minimum values, according to expression (5). For the health dimension, the geometric mean of the two sub-indices (variable PYLL and variable perception of workers about their personal health), it is calculated using (6); 2) to calculate the geometric mean, used to determine the HDI, composed of the values obtained for each dimension, according to (7).

$$Dimension\ Index = \frac{Real\ \ Value - Minimum\ Value}{Maximum\ Value - Minimum\ Value} \quad (5)$$

$$Health\ Dimension\ Index = \sqrt{PYLL\ Personal\ Health\ Perception} \quad (6)$$

$$HDI = \sqrt[3]{I_{health} I_{education} I_{income}} \quad (7)$$

Results and analyses

The results obtained are disclosed below, showing those Chilean regions with the highest and lowest outcomes in terms of the HDI for the construction industry. Note that the regions of Aysén and Magallanes are not included. A discussion of the results is also presented, comparing them with conventional HDI reports in Chile. Based on the calculation methodology described above, the results of the HDI are shown in Table 1, classified by dimension, region and country.

Table 1: HDI results by geographic region

Region	Income dimension index	Education dimension index	Health dimension index	HDI
Taparacá	0.513	0.655	0.647	0.601
Antofagasta	0.663	0.635	0.626	0.641
Atacama	0.811	0.696	0.578	0.688
Coquimbo	0.529	0.684	0.623	0.609
Valparaíso	0.503	0.652	0.620	0.588
O'Higgins	0.467	0.617	0.608	0.559
Maule	0.419	0.641	0.635	0.555
Bío Bío	0.413	0.640	0.635	0.552
Araucanía	0.399	0.639	0.661	0.552
Los Lagos	0.417	0.615	0.671	0.556
Los Ríos	0.376	0.638	0.641	0.536
Arica y Parinacota	0.441	0.642	0.575	0.546
Metropolitana	0.497	0.623	0.611	0.574
Average m	0.496	0.644	0.625	0.581
Std. Dev. s	0.116	0.023	0.027	0.042
CV	0.234	0.035	0.043	0.072
Chile	0.477	0.635	0.624	0.574

Regarding the coefficients of variation CV shown in Table 1, the highest value is observed in the Income dimension, evidencing the heterogeneity between wage opportunities for construction workers of different regions. Based on the information presented in Table 1, Figure 1 shows the results graphically. In relation to the curve showing the results of the HDI, it is observed that the construction workers belonging to the regions located in the north of the country (Antofagasta, Atacama and Coquimbo mainly) have better outcomes than those from other regions. An even more remarkable situation in the results of the income dimension curve is observed, particularly for the

region of Atacama. Regarding the education and health dimension curves, it can be noticed that both have a similar distribution for different regions.

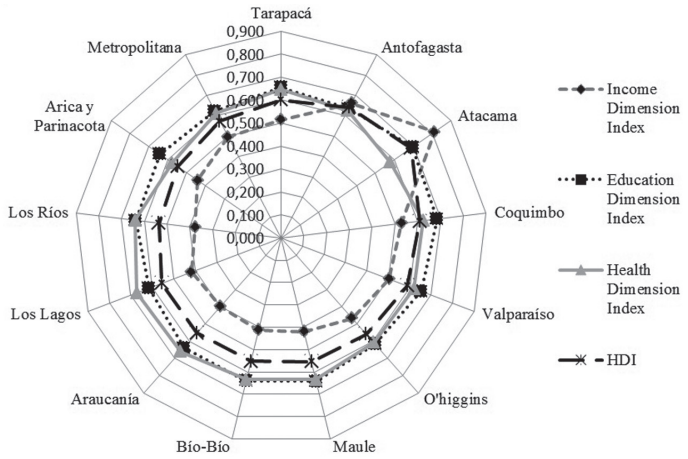


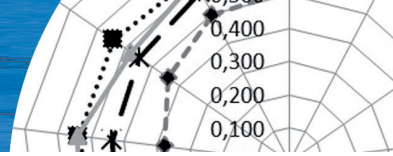
Figure 1: HDI by region and by dimension sub-indices

Table 2 shows the HDI values according to three categories called high, intermediate and low results for each dimension. In terms of the percentage change, it is observed a 24.84% between the highest and lowest values of the HDI for the construction industry. Minor variations are observed for education and health dimensions, with 12.36% and 15.41% respectively. However, the income dimension has a high variation, which reaches 73.29 %.

Applying the Kruskal-Wallis statistics test at 0.05 significance these percentage changes will then ratify. This non-parametric statistical hypothesis test was chosen because it was not possible to assume the data was normally distributed and the sample sizes were not large, which are assumptions required by parametric tests (Kruskal and Wallis, 1952). It is further noticed that the regions that concentrate the highest values for the HDI correspond to those located in the mining area of the country (Atacama, Antofagasta, Coquimbo and Tarapacá), while the lowest values are in regions located at the other end of the country, where mining is not a prevailing activity (Bío Bío, Los

Table 2: Classification of regions as results

Global HDI and for Dimension	Results highest values			Results intermediate values			Results lowest values			% of difference between the highest and lowest value in respect to the average
	Regions	Max	Min	Regions	Max	Min	Regions	Max	Min	
HDI	Atacama Antofagasta Coquimbo Tarapacá	0.688	0.601	Valparaíso Metropolitana O'Higgins Arica/ Parinacota Maule	0.588	0.555	Bío Bío Los Lagos Araucanía Los Ríos	0.552	0.536	24.84
Income dimension	Atacama Antofagasta Coquimbo Tarapacá	0.811	0.513	Valparaíso Metropolitana O'Higgins Arica/ Parinacota Maule	0.503	0.467	Los Lagos Bío Bío Araucanía Los Lagos	0.417	0.376	73.29
Education dimension	Atacama Coquimbo Tarapacá Valparaíso	0.696	0.652	Arica/ Parinacota Maule Bío Bío Araucanía Los Ríos	0.642	0.638	Antofagasta Metropolitana O'Higgins Los Lagos	0.635	0.615	12.36
Health dimension	Atacama Antofagasta Coquimbo Tarapacá	0.671	0.641	Maule Bío Bío Antofagasta Coquimbo Valparaíso	0.635	0.620	Metropolitana O'Higgins Atacama Arica/ Parinacota	0.611	0.575	15.41



Lagos, Araucanía, Los Ríos).

Regarding the income dimension, its highest values are consistent with the highest values of the HDI for the construction industry; the same for the lowest values. This can be explained by the high coefficient of variation of this aspect, compared to the low coefficients of variation of the health and education dimensions. Thus, with small variations in health and education, the high variation in the income dimension significantly affects the fluctuation of the HDI values in construction.

In the education dimension, values are distinctive because some regions with a high value for the HDI in construction have low values in education (*e.g.* Antofagasta). Other regions rise up to the average level of Table 2 in this dimension, such as the regions of Bío Bío and Araucanía. The health dimension also has peculiar values, such as those regions having the lowest values for the HDI in construction are located at the top of the health dimension ranking (*e.g.* Los Lagos, Araucanía and Los Ríos). The opposite occurs with the Atacama region (number 1 in the HDI ranking of construction), which is located near the bottom in terms of health. In order to determine whether HDI values show significant statistically differences between the geographical regions of Chile, the Kruskal-Wallis test was applied.

Table 3 shows that the values for the HDI in construction and its corresponding income dimension have significant differences in Chile. In other words, the HDI of the construction industry and the income dimension are not significantly the same for all regions; however, the education and health dimensions are statistically similar.

Table 3: Differences in the HDI by index and region according to the Kruskal Wallis Test

Evaluation	p-value	Accepted hypothesis
HDI	0.0421	H_a = the regions are not equal in terms of HDI
Income Dimension Index	0.0050	H_a = the regions are not equal in terms of IDI
Education Dimension Index	0.8408	H_o = the regions are equal in terms of EDI
Health Dimension Index	0.1013	H_o = the regions are equal in terms of Health Dimension Index

According to statistical analysis, it was found that those significant differences presented in the HDI in construction and in the income dimension mainly correspond to the regions of Antofagasta and Atacama (mining areas located in the north of the country) compared to the regions of O'Higgins, Maule, Bío Bío, Araucanía, Los Lagos and Los Ríos (southern regions of Chile) as shown in Table 4.

Contrast between HDI for the construction industry and conventional HDI for Chile

In the global Human Development Reports, Chile is in a relatively favourable position compared to other countries, being in the 40th position out of 186 analyzed countries (UNDP, 2013). Despite this position in the world ranking, there are differences between regions, where the Metropolitan area (Santiago, the capital of Chile), is definitively better ranked than the rest of the country. However, when comparing the conventional HDI with

Table 4: Comparison between regions with significant statistical differences

Significant differences for comparison between regions according to HDI													
Region	Arica / Parinacota	Tarapacá	Antofa-gasta	Atacama	Coquimbo	Valpa-raíso	Metropo-litana	O'Higgins	Maule	Bío Bío	Arau-canía	Los Lagos	Los Ríos
Tarapacá				*									
Antofa-gasta									*	*	*		*
Atacama	*				*		*	*	*	*	*	*	*
Significant differences for comparison between regions according to income dimension													
Region	Arica / Parinacota	Tarapacá	Antofa-gasta	Atacama	Coquimbo	Valpa-raíso	Metropo-litana	O'Higgins	Maule	Bío Bío	Arau-canía	Los Lagos	Los Ríos
Tarapacá													*
Antofa-gasta								*	*	*	*	*	*
Atacama					*			*	*	*	*	*	*

the HDI for the construction industry calculated here, the ranking positions differ by region. Those differences in both rankings are shown in Figure 2a.

In regard to the results of the HDI, both studies present differences; the best and worst results do not correspond to the same regions. Similar situations are found when separating the HDI by specific dimension. In the income dimension, the region of Atacama is highlighted, because its index for the construction industry obtains the best result (highest ranking), but for the conventional HDI (for the total population), this region shows some of the lowest values (Figure 2b). In the education dimension (Figure 2c), the Metropolitan region is highlighted; for the construction industry its index lies on the lowest values in the ranking, but for the total population it reaches the highest position. In the case of the health dimension (Figure 2d), other remarkable aspect is that the Atacama region is ranked within the lowest positions for the construction industry; however, for the total population lies on the second place.

From these comparisons, it can be stated that the levels of human development for construction workers are not consistent with the levels of human development of the total population for their respective regions. Therefore, it could be noticed that the human development of these workers, is an own characteristic of the construction industry.

Discussion

In general, the variation of HDI values for workers in the construction sector is affected largely by wage inequality throughout Chile. This is seen in the large gap between the per-capita monthly maximum and minimum wages, used to calculate the income dimension, where the maximum values correspond to a minority of the country. This difference in salaries can be associated with the increased investment in mining construction located in the northern regions, compared to the rest of the country; the mining regions (Antofagasta and Atacama), account for the 54% of construction investment, according to CChC (2011). In this way, the direct relationship between the HDI and their respective dimensions could mislead to the idea of workers in mining construction (with the highest salaries), have access to better living conditions. However, this is not necessarily true, because the highest values for the HDI dimensions were obtained by the education

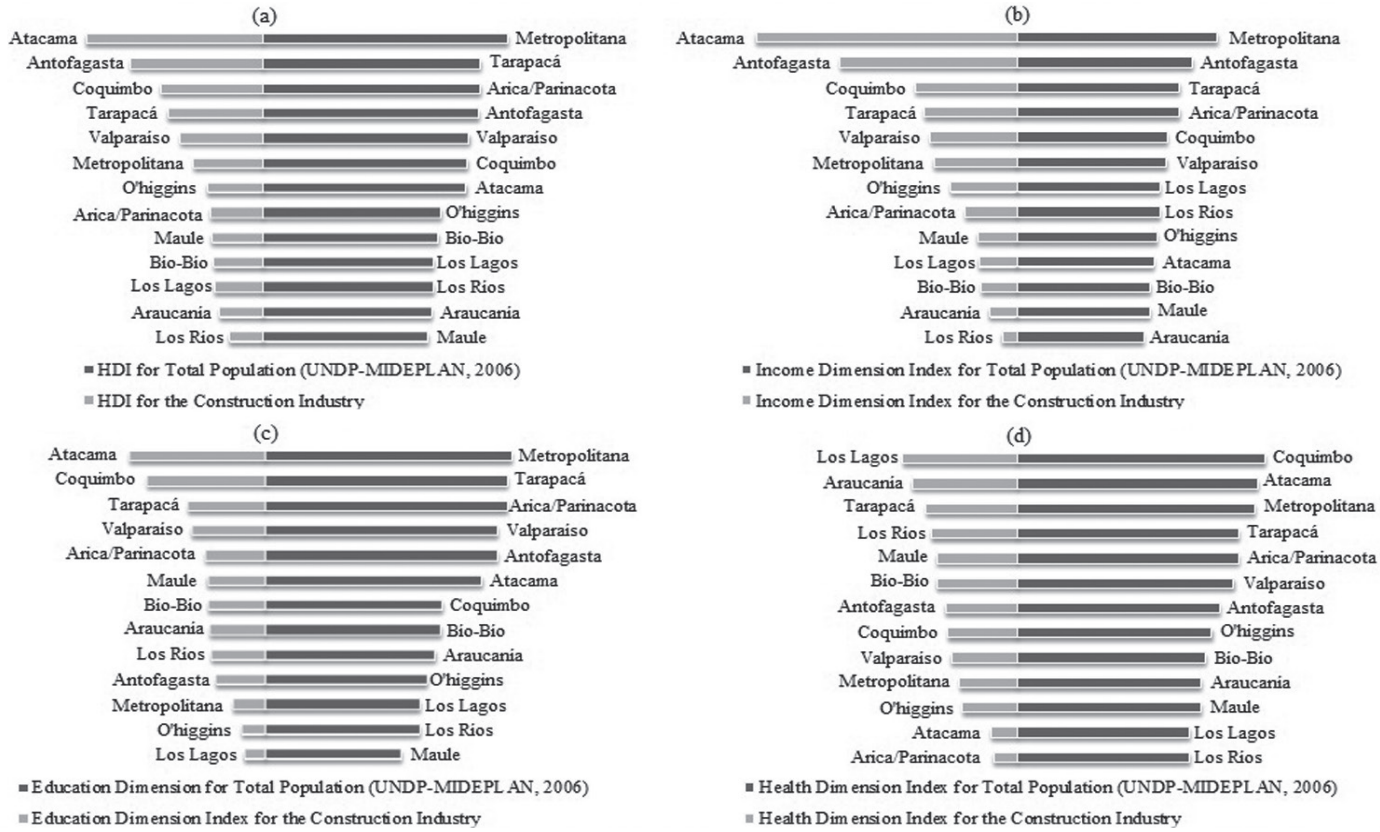
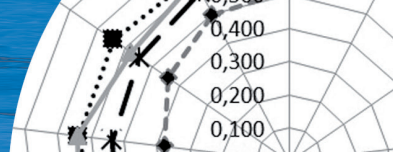


Figure 2: Comparison of the conventional HDI versus the HDI for the construction industry.



dimension, then the health dimension and the last one the income dimension. In other words, the variations in the HDI are explained by the large variations of the income dimension; however, high salaries do not imply a high level of human development, since the highest values of the HDI dimensions were found in education and health.

Regarding with the education dimension, there are similar educational levels between all regions, but with a wide range of salaries. On the other hand, the average results obtained in the education dimension are greater than the income dimension. Nevertheless, the greatest values for the education dimension are in contrast with what is described by various authors, who state that the field of construction is one of the sectors that more absorb less skilled work (ILO, 2001; de Souza, 2000). In terms of health, this dimension reaches only mean values (Table 2), given the risky conditions inherent to workers in construction. This could confirm that the construction sector usually implies one of the greatest risks for the health of workers (Hinze and Russell, 1995; Pollack *et al*., 1996; ILO, 2001; Hinze and Teizer, 2011). Accordingly, the General Union of Workers of Spain states that the health of construction workers worsens over the years, mainly until impeding physical activity, reaching the end of their working life with a worse physical health than in other jobs (UGT, 1999).

Conclusions

This research made possible to calculate the HDI for the construction industry, according to the approach used to calculate the conventional HDI, based on Chile as a case study. (without the regions of Aysén and Magallanes). Statistically significant differences between construction workers from different regions of Chile were found. The northern regions, located in one of the most important mining areas worldwide, with large construction projects, showed significant differences compared with other regions of the country. Breaking down the HDI in its respective dimensions, it was observed that the income dimension has the greatest inequality between workers in different regions, quite greater than the education and health dimensions. By contrast, education and healthcare of construction workers did not differ significantly between regions. In other words, it was found that the HDI in construction varies geographically with the variation in the income dimension, but not with respect to education or health dimensions. After comparing these results for the construction sector with the conventional HDI differences were found. This would confirm that workers in construction differ from workers in other sectors.

Finally, although the income dimension made a major impact on the HDI for construction in those mining regions of Chile (where wages are high), this does not allow expanding this phenomenon to the rest of the country, where the education and health dimensions were greater than the income dimension. This coincides with Sen (1997), who mentions that although economic prosperity helps people to live a freer and more fulfilling life, a better education and good healthcare services do too. In line with this statement, it should also be noticed that a higher human development of construction workers, can positively have an influence on the economy of the country, since according to Ranis and Stewart (2001), the higher the human development the greater the growth, due to that a healthier and educated population contributes to improve the economic performance, in this case, of the construction industry.

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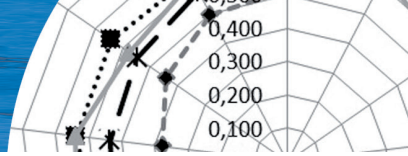

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