

# An Empirical Approach of the Impact of the Human Capital Engineering towards the Lean Manufacturing Organizational Performance

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## Abstract

This qualitative investigation, holistically evaluates the Human Capital Engineering (HCE), as a contemporary mean, to obtain the manufacturing quality upgrades, required by the new age industrial demands.

This research aims to unveil several myths upon the HCE as an intangible asset and its direct impact over the adoption, of the newly corporate strategies, that lead the young entrepreneurs into the lean manufacturing organizational modelling. On the other hand, besides exploring the contemporary lean tendencies, this analysis also aims to expose the various benefits obtain through the Human Capital conditioning, based upon the lean manufacturing principle “0% wastes”.

Parting from the above, it is of great importance to explore the barriers faced by the newly born entrepreneur projects/initiatives, who are focused on the production of goods, generated by the specific limitations over the current technological acknowledgements, that stimulates the growth of a significant gap between their performance features and the World Class Corporations competitive traits.

Nonetheless, besides the technological acknowledgement absorption, the HCE integral implementation, also faces a great hazard among the merging economies due to the heavy globalization pace, dictated by the extremely competitive labor markets, who continuously supply a significant bulk of professionals, that still lack the skills and qualifications demanded by the world class corporation standards.

**Key Words:** Globalization Pace, Lean Manufacturing, Benchmarking, Human Capital, Entrepreneur.

## Introduction

The internationalization of the current technological manufacturing traits, plus the creation of the firsthand business/commercial scenarios, into potential competitive clusters of manufactured products and services, is a clear reference, of how the evolution of the tools and different productive means have mutate, due to the best known market capitalism principle “the survival of the fittest”.

Now a days, despite their monetary, technological or operative limitations, each company is now jeopardized by the current new client taste and volatile consumption patterns, that present no warrants in

respect to productive forecasting stability. Thereby, inferring that almost every company needs to aim and directly point towards a symmetrical pattern of personnel, able to adapt their personal goals, into corporate objectives that need to be translated into leaner strategic skills.

With the objective of exploring the HCE effectiveness and applicability, this investigation, approaches 2 main variables:

- The Contemporary Human Capital Engineering Techniques.
- The Lean Manufacturing Organizational Key Performance Indicator (KPI's) and it's Best Practices over different manufacturing sectors.

Were, the core analysis of this investigation, is based upon the Lean Manufacturing dependance over the contemporary Human Capital Engineering techniques (Please revise figure No 1). And its side effects over the continuous Human Capital Valorization.

### Figure No 1 Investigations Main Variables

**A:** The Contemporary Human Capital Engineering Techniques.

**B:** The Lean Manufacturing Organizational Best Practices, over the various merging productive sectors.



**Source:** Self Interpretation

This document approaches the investigations among the 3 benchmarking key momentums (Please revised figure No 2,), which are:

1. Stage of Diagnose, phenomena know how acquisition and problem acknowledgement.
2. The Point of Inflexion, where the human Resources Management, adopts a maleable position through Revalorization of the Staff, with the use of Human Capital Engineering.
3. The Evaluation of the tools effectiveness and positive impacts generated on the company, through the different lean manufacturing stimulus.

Where the Lean Manufacturing KPI's are diagnosed, measured, rendered, compared and upgraded threw various alternative Human Capital Organizational Measures, driven by the strategic levels of each corporation.

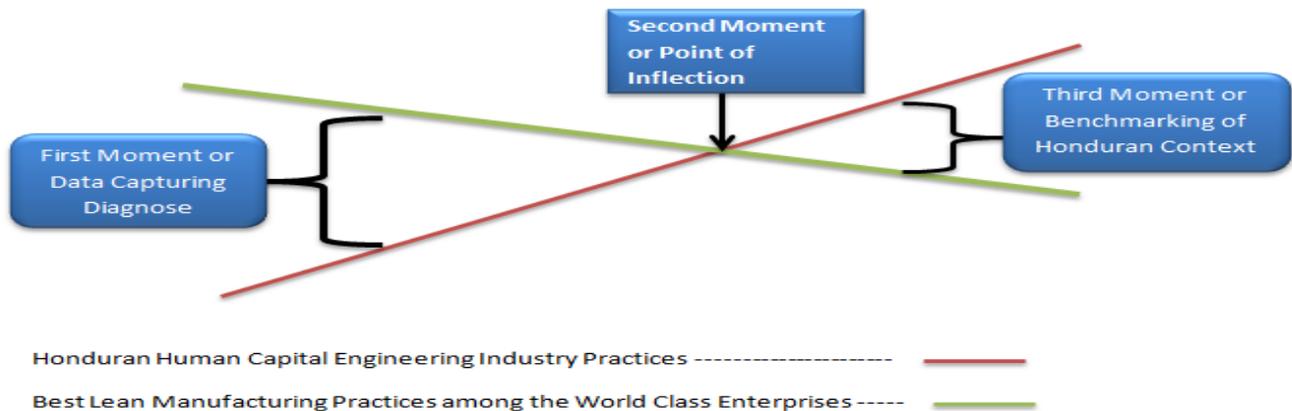
### **Investigations main goal:**

Determine and Identify the Impacts and benefits gained by the World Class Companies, through a proper Human Capital Engineering (HCE) process.

### **Specific Objectives:**

- The identification of the Human Capital Engineering Key Performance Indicators, through a theoretical background search.
- The identification of the benefits and impacts of a fully integrated Human Capital Engineering process.
- The description of the specific traits, processes and activities, that assemble the best Human Capital Engineering Practices.

Figure No 2 The 3 Key Momentums, of the Human Capital Engineering incidence, over the Lean Manufacturing of the Services in Honduras.



Source: Self Interpretation

### 1.1 HUMAN CAPITAL MANAGEMENT EVOLUTION

The contemporary workforce is not what it used to be, due to the various complex evolutions on the markets accelerated pace, ever since most of the “new age” foreign companies, tend to adopt a horizontal organizational scheme, towards a virtualized and automated project based staff professionalization process, where workers are less tethered to traditional offices and set hours. The continuous growth of the labor markets, suggests a combination of the different genders ethnicity, religions and generations, that clearly demonstrate that today's workforce is more diverse in every sense of the word. “Where workers expectations, needs and definitions of success vary widely” (LLP, 2011).

Parting from the above, we could state that the Human Capital Management (HCM) and conceptualization has suffered dramatic alterations across time, who cross fires the employees perspectives of the tasks required for a specific job, running into a multifacetic range of auditing/monitoring techniques, developed by the employer.

The human capital concept evolution, can be tracked, since the 17<sup>th</sup> century, by Sir William Petty, who placed a value on the english laborers, in order to demonstrate the countries current industrial power and war technological potentialities.

Later on the 1850's William Farr, developed a forecasting method, based on the predictions of the human future earnings, which he defined as:

$$\text{Earnings} - \text{Living expenses} = \text{Wealth Representation},.$$

Despite the great management advances on the following periods, driven by the industries and emerging markets, the great barrier towards the approach of the Human Capital (HC) wasn't overcome, until PhD. Theodore Schultz promulgated the movement of “Educational Capital” in 1961 (Rockford, 1999), where he blended the concepts of corporate investment and corporate consumption, in a homogenous pattern that identified 5 main areas of H.C. Stock, which are:

- Health Care
- On the Job Training
- Formal Education
- Migration

- Extension Programs

Where the H.C.E. and Lean performance measures are bonded, and can be found, through the “On the Job Training” basis component.

Although, before we describe the articulation between this 2 topics, we must depict each variables: main characteristics, inflection points and development scenarios, in order to properly describe their impacts and relations.

## **1 HUMAN CAPITAL CONCEPTUALIZATION**

### **1.1 WHAT IS HUMAN CAPITAL?**

Human Capital is generally referred to the stock of competences, knowledge, social and personal attributes, embodied in the ability to perform labor, so as to produce economic value (Simkovic, 2012). Although this particular concept has evolved through time and adapted among a series of particular features that have upgraded its basic composition, the new management strategies are one of the most significant evidences of its best strategic means to control the new era of corporate performance requirements.

Generally, when we approach the term Human Capital (H.C.), we are used to conceptualize it as a merely intangible asset to an organization.

Although, nowadays, the Organizational H.C. is viewed, as potential corporate mean, to stimulate the companies competitiveness on the market (Quesada, 1995). The valuation of the Human Capital potentialities, has evolved through time, with new significant features, in such a pace that even the low budget firms, have acquired several HCE modules, that enhance their employees abilities, skills and capabilities, to a moderate and efficient control of their performance, to the point where several studies have determined that, the proportional intensity of an investment over their human capital assets, leads to a greater accomplishment of their long term goals (Schultz, 1961).

For instance, one may support statements, referred by the R. Almeida and P. Carneiro investigations, who clearly validated the hypothesis, over the firms who invested on their associates, where the rates of return of the income invested reflected a significant superiority over the regular basis returns on machinery, technology and others (between 17%-24%), suggesting that the companies, whose job training techniques directly stimulate the H.C., reflect a significant result upon their medium and long term expectations (Heike, 2002).

Similar to these investigations, the industrial scientists : Brooks, Hairstone and Nafucho, concluded from an extensive exploration of the theoretical background and a qualitative research upon Human Capital potentialities, that a strong correlation exists among how the companies who apply specific strategies over the Organizational Human Resource Development (HRD) and the Organizational Productivity key performance indicators (who evaluate individual and collective employee performance); where the productivity is triggered by the associates empowerment and process acknowledgement (Heike, 2002).

### **1.2 WHAT IS HUMAN CAPITAL ENGINEERING?**

We could define the Human Capital Engineering (HCE) process, as a mutation product, of the performance management best practices, that attends the creation or transformation of a work environment or setting in which people are enabled to perform over an idealistic theoretically based scenario and thereby deploy all their skills and abilities on the tasks they are responsible for (Brookman, 2006).

Among the critical paths of the HCE, we could state that the main activities for its achievement are based on the following processes:

- The development of a clear job description, that identifies and precisely determines the academic, skills and complexness of the tasks required for the proper execution of a task.
- The meticulous selection of the proper personnel.
- The supply of effective education, training and orientation programs to the company associates.
- Provide ongoing coaching and feedback information, over the employee performance.
- The supply of promotional and career development opportunities to the employees.
- The design and modeling of effective compensation and recognition systems, that reward the personnel contributions.

Where as for today's economy, the HCE, has become a strong competitive and innovative tool, to many leading corporations on the globe (Muhamad, 2012), by providing the following benefits:

- Enhancing individual and collective performance.
- Stimulating the organizational structures of each manufacturing unit.
- Improve hiring practices
- Improve employee retention.
- Integrating the aggregated value of each Supply Chain Management corporate instance.

On the other hand, the Human Capital Stock at all levels if pushed to its maximum, can be extremely efficient to the macroeconomic development context of any country (Cornachione, June 2010). According to the Hans Heike theory, the payoff of the HCE strategic investments, can be quantify through a 2 way methodology, that clearly describes the return rate of investments for the companies optimization processes (Heike, 2002), which are:

1. Indirect Payoff rate of the HCE investment

Where the Heike studies, have demonstrated, that the specific trained and stimulated competences, acquired on a company by an associate, directly support the higher education foundations, with the articulation of a exogenous variable defined as "experience absorption cycle" (Heike, 2002).

2. Direct Payoff rate of the HCE investment

Several investigations upon the direct Payoff, over the associate formation, generally relate its performance tendencies, to the rate at which their employees, capture the core objectives, fundamentals and principals of their daily labor practices and apply them on a coordinated and fully automated pattern (Heike, 2002).

On the other hand, we can infer that this rate of return, refers to a short term experience acknowledgement of the employee performance.

## **2 Lean Manufacturing:**

### **1.1 What is Lean Manufacturing?**

Whenever we refer to Lean Production, Manufacturing or simply Lean, as a production practice, that considers the optimization of resources, with the specific goal of creating value for the end customer, we may probably address the Toyota Production System (TPS) who absorbs and captures the true essence of efficiency and optimization. This manufacturing philosophy, is the product of the mutation and evolution of the fittest companies in the market, who pursuit the constant market adaptation.

This movement started in the early 1890's, through the studies of Frederick Winslow Taylor, who began to study the individual operators and their working methods, leading to a particular industrial performance instrument defined as the "Scientific Method".

Once the Winslow model was fully comprehended, the Industrial Scientists Lillian and Frank Gilbert, incorporated motion and motivational stimuli to this instrument, generating the development of a new tool defined as "Process Charting", who contributed to the transportation, logistic patterns, company's layout planification and the association between the employees attitude and its incidence towards its job monthly performance (Dailey, 2003).

Later on the mid 1910's Henry Ford and Clarence Sorensen, redefined the Winslow instrument, into fully integrated system, with specific tasks and state of the art technology, by conforming the newly functional automated assembly lines, suitable for the moderately trained workers.

Although, the Ford Model T Manufacturing, demonstrated efficiency through time, the market started to challenge the Ford Corporation with bigger HCE quality quests, who demanded the study and methodology upgrading from different scholars and scientists, such as Edward Deming, who was able to determine the markets current quality standards and thereby, conceive the corporate Total Quality Management assessment strategies, as a direct mean to approach cost minimization (Corbett, 2003).

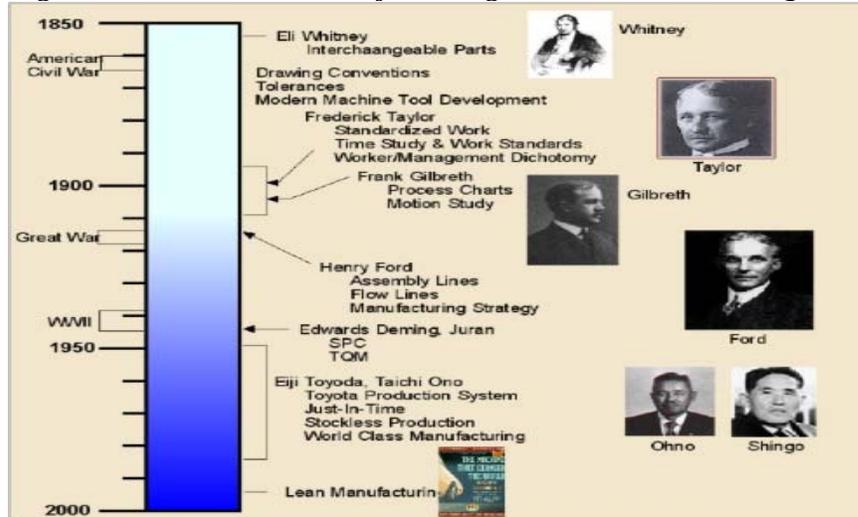
In time, the Japanese industry, consolidated all the theoretical background of performance, optimization and cost reduction protocols, by reconstructing the evolution of the current industries Key Performance Indicators (KPI's) and their best practices, with the use of their own model, defined as the "Toyota Production System" (TPS), who now a days still remains as part of the global World Class Manufacturing (Ohno, 1998).

In time, the study of the TPS standardized the perspectives, that lead to the contemporary research, over the uncomprehend impacts, over the global manufacturing framework.

The TPS new tendencies and its theoretical universality, among the different industries and economic context, drove the lean manufacturing processes (derived from the Japanese philosophy), to focused on the minimization of the seven waste categories:

1. Unnecessary Transportation tasks.
2. Unnecessary Inventory.
3. Unnecessary risky motion tasks.
4. Imprecise timing and bottle necks on the processes.
5. The over processing of a unit (Unnecessary costs).
6. The Over Production of a specific product, who do not counts with the required demand, to pull it quickly on the market.
7. Product Defect minimization.

**Figure No 2 The lean Manufacturing Time Line Linear Sequence**



Source: [www.strategosinc.com/just\\_in\\_time.htm](http://www.strategosinc.com/just_in_time.htm)

## 2.2 What are the Lean Manufacturing main Benefits?

“Lean Manufacturing is an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste” (Rockford, 1999).

As previously mentioned this strategy is derived from the TPS and is the source of key to increase the value added production main features.

Despite the tangible and direct benefits of the lean manufacturing lower costs, shorter lead times and quality upgrading, we may perceive the additional values of its application, such as:

- Single-piece production.
- Repetitive order characteristics.
- Just-In-Time materials/pull scheduling.
- Short cycle times.
- Quick changeover of tools, equipment and personnel.
- Continuous flow work cells.
- Collocated machines, equipment tools and personnel.
- Compressed space.
- Multi-skilled employees .
- Flexible workforce.
- Empowered employees.
- High first-pass yields with major reductions in defects.

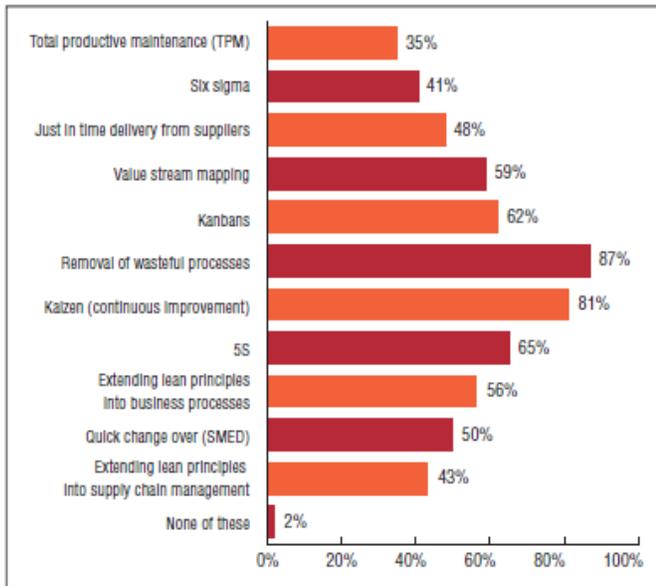
Parting from the above, we can state, that the lean manufacturing benefits, are based upon the main project management principles:

- Resource efficiency and usage maximization.
- Output timing and staff performance.

In fact, we could state that the Lean Manufacturing culture, has created an enormous impact, over the different industrial new era frameworks, to the level, that 12 of main productive currents,

approached by the World Class Corporations, derived from this particular concept and are focused on the same waste reduction goals (please revise figure number 2).

Figure No 2 Lean Manufacturing Contemporary Tendencies.



**Source:** Support Lean Manufacturing Principles with IBM Maximum Asset Management (2007), from the World Class Manufacturing Report, collected by the Tivoli group.

As one may appreciate, on the figure No 2, the removal of wasteful processes is still, the one of the most referred tools across the globe, next to the kaizen philosophy, were, the industry usage among this optimization instruments have outnumbered the common administrative practices, towards the integration of the whole productive system, into a single automated process.

### 2.3 How can one achieve the Lean Manufacturing Maximum Efficiency?

The maximum efficiency of the lean manufacturing productive system, is reached through a based performance instrument, defined as: The Theory of Constraints, that procures and offers the resources required to achieve the targeted benefits planned in a medium and long term time line (Dettmer, 2011).

Lean manufacturing is stereotyped, by the world class plant managers as a long term indicator, that provides precise a benchmark over the internal operative and manufacturing affairs that surround the company. Therefore, the Theory of Constraints, states, that among the main factors, that determine the Lean Manufacturing maximum efficiency characteristics, we may state, the main KPI's for these objectives (Performance, 2002), are the following:

1. Manufacturing Flow
2. Human Capital Organization (HCO)
3. Process Control
4. Metrics
5. Logistics

But on this research, it is necessary to mentioned that among the 5 main pillars of the Lean Manufacturing Performance rates, this investigation will only explore the HCO perspective. Through an extensive recognition of the global workforce analytics, from a Human Capital Engineering scope.

#### 2.4 Lean Manufacturing Performance, through innovative organizational matters

The Lean Manufacturing Performance presents empirical evidence of a strong relationship between Human Capital Engineering, Innovation and productivity enhancement. Where Black and Lynch (1996), state, that investment in human capital in the “On the Job Training Area” and education are the driven force behind the productivity and competitiveness upgrading, by arguing that HCE raises overall productivity, as the Human Input, to economic upgrades, in terms of physical and economic activity and gained intellectual efforts (Muhamad, 2012).

**Figure No 3 Innovation Capacity Index 2010-2011 Clusters**

<b>High Income Countries</b>			
<b>Name of Country</b>	<b>ICI Score</b>	<b>Name of Country</b>	<b>ICI Score</b>
Sweden	80.3	Portugal	56.7
Switzerland	78.1	Italy	56.7
Finland	76.1	Malta	54.6
United States	74.8	Greece	49.9
Denmark	74.3	Taiwan	72.5
Canada	73.6	Israel	67.5
Netherlands	72.8	Republic of Estonia	60.5
Luxembourg	72.2	Hungry	56.8
Republic of Korea	72.1	Slovak Republic	56.7
Norway	72	Cyprus	55.2
New Zealand	71.3	Republic of Croatia	53.2
United Kingdom	71.3	Trinidad and Tobago	47.7
Japan	70.2	Singapore	76.7
Australia	69.4	Hong Kong	71.4
Ireland	69.1	Bahrain	57
Germany	68.9	Qatar	55.9
Austria	66.7	Oman	51.8
Belgium	66.1	Kuwait	51.3
France	65.3	Spain	58.8
Republic of Slovenia	59.1	United Arabs	58.9

**Sources:** Innovation of Development (2010-2011 Report)

Where the High Income countries strongly suggest a high evolution in innovation through HCE enrichment in investigation acknowledgement and the application of the Industries, state of the Art Technology.

Were Suriyani Muhammad, concludes, that Human Capital is a strong Catalyst of Innovation, since, the practice generated by innovation may imply the construction of connections (networking conditions) that involve better understanding, training and support for the continuing preparation process, over a KAIZEN lean Manufacturing implementation (Muhamad, 2012).

### 3 Human Capital and Lean Manufacturing

#### 3.1 Human Capital Engineering Evidence, as a lean Production Stimuli

Among the most valuable theoretical evidence, we could out stand the Thomas Gilbert work piece, defined as: “Human Competence, Engineering Worthy Performance”, in 2004, where the generation of his 3 leisurely theorems: Upon the measurement and Auditing of Human Capital Competence. Where T. Gilbert consolidates and homologates the performance management tools upon the Human Capital Engineering 6 main KPI’s (Jamal, 2011), that are disseminated over 17 variables whose main goal, is based on the Employee performance auditing:

<b>Data</b>	<b>Resources</b>	<b>Incentives</b>
Relevant and Frequent Feedback about the adequacy of Performance	Tools, resources, time and materials of work design to match the performance needs	Adequate Financial Initiatives
The Performance Expectations descriptions		Non- Monetary Initiatives
Clear and Relevant Guides to Adequate Performance		Career Development Opportunities
		Risk Management of Work Performance
<b>Knowledge</b>	<b>Capacity</b>	<b>Motives</b>
Systemic Training Design	Flexible Scheduling of Performance	Psychological Assessment towards productivity
Placement/Feedback	Prosthesis or Visual Aids	Recruitment of Personnel who match the roles required
	Physical Shaping	
	Adaptation	
	Selection	

**Source:** Human Competence Engineering Worthy Performance Thomas F. Gilbert, 1978

Where parting from the usage of this common goal surveillance tools, one can monitor the individual and collective productivity of their associates, over a specific project, activity or tie period, in

a linear progressive manner, thereby, enabling a complete evaluation of the performance curve of each employee or/and operational unit.

Therefore the common use for a Tool of these nature, creates a sequence of positive impacts, who were described and categorized by the Manufacturing Performance Institute and the American Small Manufacturers Coalition, on their 2011 research, defined as: “Next Generation Manufacturing studies”, who surveyed and categorized 824 US manufacturers, stating that the new tendency for the companies who have reached the World Class Human Capital Engineering, are more likely to invest in this asset, were at some point of their evolution cycle (even in the manufacturers whose denomination is furthest from world class status), a significant rate of acceptance towards the prioritization of the HCE reflects 68% near/at World Class Category vs. 41% furthest to the World Class Denomination (Manufacturing Performance Institute, 2011).

Besides this general overview of the World Class Corporations, the investment on the HCE and its dynamic absorption of the industries new traits, the Next Generation Manufacturing Study, was able to determined that the closest one organizations pace is towards the acquisition of the World Class denomination, the greater the proportion of the investment towards the HCE processes, in order to obtain superior performance levels (revise Table No 1).

**Table No 1 World Class Best HCE Standards**

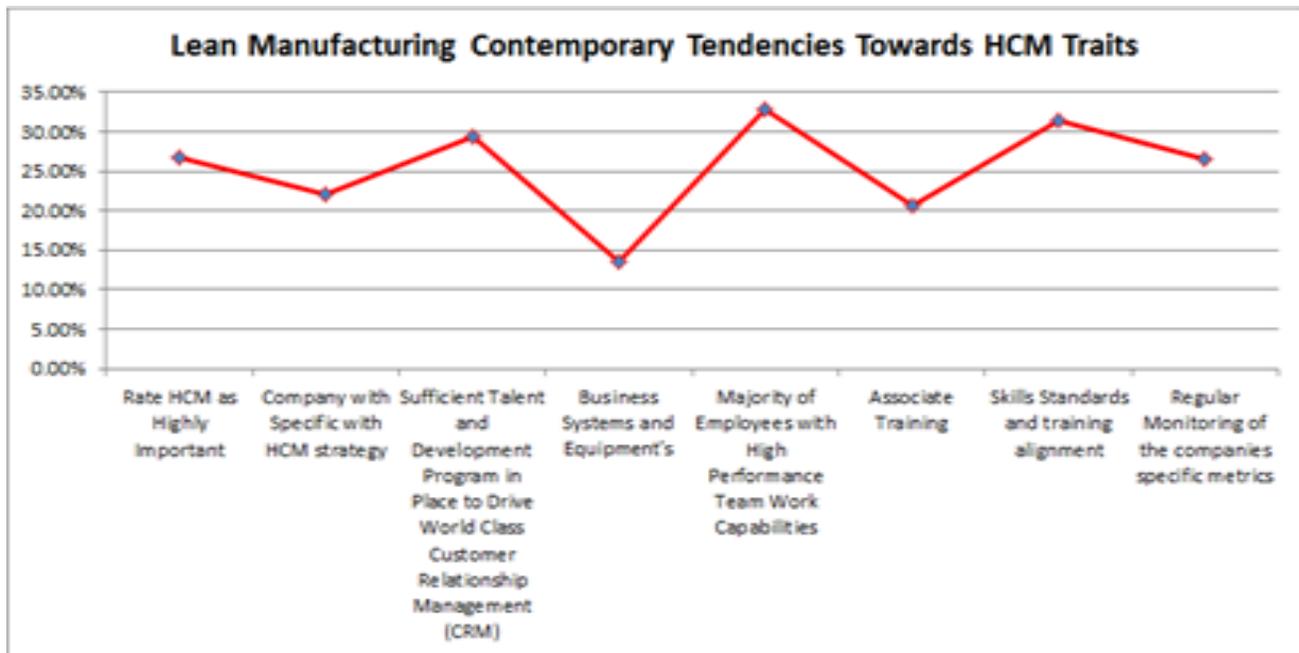
<b>World Class Strategy and Practices</b>	<b>Furthest From World Class HCM</b>	<b>Near or at World Class HCM</b>
Rate HCM as Highly Important	40.7%	67.5%
Company with Specific with HCM strategy	5.9%	28%
Sufficient Talent and Development Program in Place to Drive World Class Customer Relationship Management (CRM)	9.6%	38.9%
Business Systems and Equipment's	5.2%	18.7%
Majority of Employees with High Performance Team Work Capabilities	37.1%	69.9%
Associate Training	25.7	46.3
Skills Standards and training alignment	32.8%	64.2%
Regular Monitoring of the companies specific metrics	11.6%	38.2%

**Source:** Next Generation Manufacturing Study, The Manufacturing Performance Institute, 2011

Table No 1, determines the core elements of HCE over the contemporary US World Class Companies, who pursuit continuous growth and quality upgrading schemes, by simply adjusting this 8 performance layers, that describe the World Class HCE Strategies and its time deviations over the 2009-2011 time periods, who clearly demonstrates, that even the new small business manufacturing companies and entrepreneur initiatives, approach the HCE component as an element for the achievement of competitive layers.

Now a days, a common pattern among the new born companies, has drove a great portion of their efforts to support their management standards, into the alignment of this HCE Best Practices to the lean Production Goals, who pursuit the maximization of efficient manufacturing procedures.

**Figure No 4 World Class HCE Deviations and Contemporary Tendencies**



**Source:** Next Generation Manufacturing Study, The Manufacturing Performance Institute, 2011

Where the investment effort allocation of the HCE, over the World Class Enterprises, is concentrated over the Multi-Disciplinary Team Capabilities that consumes less resources and increases productivity in a significant pattern, before the Skills and standard training alignments instruments, who require a specific volume of resources for it to be properly developed.

On the other hand, we could interpret that among the HCE features, the technological Business System, tools and Equipment, who procure the management automation, present the least investment source lines, among the World Class Manufacturers, from the 2009-2011 periods.

Parallel to the HCE best practices tracking and contemporary tendencies, the World Class Manufacturers, have consistently benchmark their internal affairs over the effectiveness of the talent and development programs. Through the exploration of theoretical evidence based upon the Next Generation Manufacturing Study in 2011, by the Manufacturing Performance Institute, we can firmly state, that around 25% of the studied firms, have invested a significant amount of resources, on the talented, development programs and operation enhancement, since their internal benchmarking has diagnose that 61% of these firms report sufficient talent on their working environments (Manufacturing Performance Institute, 2011).

### **3.2 Human Capital Engineering and Lean Production Achievement and Proportionality.**

The following unit of this research takes into account, the Lean Manufacturing current tendencies, stimulated by the HCE different methodologies and approaches, whose articulation, proposes the quantification of the benefits obtained through its usage.

From the evolution of both concepts (HCE and Lean Production Manufacturing), we may perceive that the great success of this instruments, in respect to productivity, is due to the business acceleration cycles that are stimulated by the strategic talent deployment over specific tasks. The recent theoretical background suggests that 78% of the manufacturers recognizes the importance of human capital acquisition, development and retention. Unfortunately, only 58% of all manufacturers report that systems and equipment meet their current requirements, which increases the investment needs to balance the Human Skills with the technological components (Manufacturing Performance Institute, 2011).

#### **Conclusions approached through the empirical evidence revision**

The success of a business strategy, towards a Human Capital organizational approach is defined as a whole, rather than being a specific manufacturing unit. Through the abilities of a business that lies on the internal pull factors, the contemporary industrial demands are focused on Human Capital Engineering, in combination with new era technological tools that support the contemporary market demands and volatile requirements.

Now a days the small business corporations quest for a world class denomination, is a complex goal to obtain, but the with help of the proper HCE accelerators, the companies metabolism can be boosted, thereby, extending their business cycles potentialities and their World Class categorization possibilities.

Finally, the HCE, has proven to be a World Class Manufacturing tendency, that explores the TPS potentialities, where the Lean Manufacturing practices are taking to the limit, over the employee individual and collective performances. Thereby confirming that the articulation of the variables defined as:

**A:** The Contemporary Human Capital Engineering Techniques.

**B:** The Lean Manufacturing Organizational Best Practices (LMOBP), over the various Latin American productive sectors.

Reflects a strong dependency over each other, where the LMOBP variable, enhances the performance of the HCE KPI'S, and therefore, upgrades the new techniques that approach the World Class companies strategic modules. On the other, the significant evidence of the positive impacts generated by the HCE's, over the resource maximization of the automated World Class Industries processes, leads this particular corporations to the Lean Manufacturing adoption, with a strict priority over the technological innovative traits.

#### **Citations and Reference Section**

- Brookman, M. (2006). *Human Capital Engineering*. Indian Creek Park way, Oregon, US: Alliance Training and Consulting Group.
- Corbett, S. (2003). *Beyond Manufacturing the Evolution of Lean Production*. Seattle, US: The Mckensey Quarterly.
- Cornachione, E. (June 2010). *Investing in Human Capital: Integrating Intellectual Architecture and Utility Theory*. Sao Paulo, Brazil: University of Sao Paulo, Colledge of Business and Economics.
- Dailey, K. (2003). *The Lean Manufacturing Pocket Book*. Nebraska, US: DW Publishing Co.

- Dettmer, W. (2011). *Beyond Lean Manufacturing: Combining Lean and the Theory of Constraints for Higher Performance*. Port Angeles US, Portland: Goal Systems International.
- Heike, H. (2002). *The Roles of Human Capital Competences and their Payoff*. Maastrich Germany: Research Centre for Education and Labor Market.
- Jamal, W. (2011). *Impact of Human Capital Management in Organizational Performance*. Islamabad: University of Islamabad Pakistan.
- LLP, D. C. (2011). *Human Consulting Trends: Revolution/Evolution*. US, Omaha: Touche Tohmatsu.
- Manufacturing Performance Institute, M. (2011). *Next Generation Manufacturing*. US Wisconsin: American Small Manufacturing Coalition Editorial.
- Muhamad, S. (2012). *Innovative Capacity, Human Capital and Its Contribution to Economic Development in Malaysia*. Terengganu: University of Malaysia, Terengganu.
- Ohno, T. (1998). *Toyota Production System (TPS) Beyond Large Scale Production*. Chicago: Clearence Center Databases.
- Performance, B. L. (2002). *H. William Dettmer*. Port Angels, CA, US: Goal System International.
- Quesada, C. E. (1995). *Metodos para medir el Rendimiento*. Mexico Distrito Federal, Mexico: Revisa Tecnica de la Empresa de Telecomunicaciones de Cuba.
- Rockford, C. G. (1999). *Lean Manufacturing*. San Francisco, CA, US: Posted on the web page, <http://rockfordconsulting.com/lean-manufacturing.htm>.
- Schultz, T. (1961). *Investment in Human Capital*. South Dakota, US: American Economic Review.
- Simkovic, M. (2012). *Risk based student loans*. US: [www.ssrn.com/abstract=1941070](http://www.ssrn.com/abstract=1941070).

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