NEW DIMENSIONS OF PRODUCTIVITY IN MANUFACTURING PROCESS AND BUSINESS ADMINISTRATION AT MULTINATIONAL MANUFACTURING PLANTS, THAT ORIENTED ACADEMIC PLANS OF INSTITUTO TECNOLOGICO DE REYNOSA, MEXICO (ITR).

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Introduction.- When studying productivity as a phenomenon with projection in the increase of productivity through the optimization of material and economic resources, the technological development, an efficient organizational structure, together with the good performance of man-power, this gives us more flexibility in order to evaluate productivity separating it in scientific, technological, manufacturing and managerial components. Productivity has deep roots in extralabor context and in its labor function, both are multi and interdisciplinary. The multifactor structure makes it sensitive to fluctuations that damage and avoid it to reach its legitimate objectives and goals. The scientific investigation, technological development, and management; let us solve problems related with productivity through the manufacturing engineering in order to obtain viability to the industrial plants and to achieve the demands of international markets into the globalize economy. Productivity is the efficient utilization of the resources for the production of goods, with a common translation in a relationship between the total of goods produced and the utilized resources, this is an obvious reason for handling both under standards analyzing the designated functions into an operative plan and also under the authorized budget . This array of ideas does not allow establish a paradigm like an exclusive model, this is the reason because we feel comfortable with operational models or real systems, supported by the wide theory behind them. This investigation is designed for finding the most important dimensions, variables and factors that in the managerial and manufacturing areas interact in order to achieve productivity.

Problematic Situation .- An exploratory study for designing this investigation we found that the manufacturing plants under study have great deficiencies and mistakes about handling raw materials, out of phase in the technological development of the operations and interaction of manufacturing processes, operative deficiencies in workstations including the man-power, lack of flexibility at exchange of manufacturing systems, deficient utilization of production uptime and installed capacity, failures in departments of Quality Control and impossibility to optimize themselves according to international standards, inconsistencies in managerial and financial exercises, also lack of satisfaction in final customers. Analysis of these problems allows us to identify dimensions, variables and factors that were damaging the productivity on those industrial plants.

Asomoza, 1985, showed that productivity of industrial plants in Mexico is a direct function compose by independent factors, harmonically changing according to environment contingencies of multiple economic, social, and political situation of labor sectors.

Theoretic Framework.- The analysis and evaluation of productivity like a social phenomenon allows us to review some models, from them we can highlight the market structure and the one of the cost reduction in the innovation, Desgupta and Stiglitz, 1980; then the monopoly activity that economic globalization support. About this particular item, A.C. Harberger established that 30% of the American economy during the first half of the Twentieth century was monopolized and for Estrin Saul, 1995, fifty years later this situation has become anguishing for businesses to survive. Ellickson Bryan, 1993, consider that economical factors through infinite dimensional spaces and with the integration of vectors, that makes much more comprehensible the general theory of equilibrium and in his perspective there are areas of high productivity in development. Asomoza, 1985, established that the maximum responsibility for reaching a high productivity, in the industrial plants is in coordinated function between the executive manager, and the person in charge of the manufacturing processes, these people have to support the innovation programs and also let the maximum flexibility in the handling of changes, without damaging the organizational environment, also without alternating the activities related with the conquer of new markets. The report # 1039 about productivity (Key to world competitiveness) prepared by " The Conference board 1993; The Peter F. Drucker Foundation", point out that the concept of productivity has change and will have more modifications in the future. Talking in terms of quantity they found that one hundred years ago, nine of ten workers were working directly in the manufacturing processes, by the end of twenty century , industrial plants in industrialized counties, in their process lines only have the twenty percent from the total of workers in the plant, the eighty percent of the man-power realize activities consider like low efficiency ones. Mechatronics, Technova, 1983, mentioned that the advance of the manufacturing areas was achieved thanks to the perfectionism of the high precision equipment and the optimal requirement of the mechanical processes associated to technological innovation on the field of electronics (mechatronic). In this field of knowledge the contribution of natural science is one percent, the solution to the problem of new materials has the ten- percent and the sciences of communication and information have a contribution of another ten-percent. According to this we can obtain that more than 70 % of efforts about new work must be in other fields with a low development of science in order to obtain new knowledge. Simon, H. A, 1981, established that the productivity level of the manufacturing system is improved through the technology, in the same way the improvement of Quality Control, educating processes and the setting of standards; these affirmations are valid, the only change seen was the fact about the decrease in training to the workers and substitute them with qualified and certified operators with a high technological instruction. Also the labor redesign was that even is so necessary for the future of manufacturing .

John E. Ettlie, 1990 makes a citation of Helmut Detter from the department of mechatronics of the Vienna Technological University in Austria, who found three fields

of technical efficiency in the productivity ; the first with low levels of technical efficiency and great problems of manufacturing activity and also low productivity . The next field has technical diffusion with increase in the manufacturing production and the third field has technical saturation, with low flexible manufacturing processes, cost optimization and high productivity. The basement on the before mentioned idea is the concept of a technical manufacturing and the lack of personnel training, that most be substitute by operators with high technological instruction.

Barry D. Baysinger, 1991, mentions about the conflict between managers , investors and people in charge of the industrial plants caused by investing projects and results on the profit results .

The economical, political, scientific, and technological advances give a new sense of inspiration and orientation to the industrial transformation in the wide industrial groups, respecting this M. Graham, 1990, and J. Galambos, 1983, these phenomenon are the expression of the effects of the investigation and the development in what the manufacturing processes are submersed . In opinion of Martin Kenney, 1993, Japan has the highest level of an informed society and reacting , through the covering of a wide interconnected operative network , where society is performer and promoter of economical development ; is the ruling philosophy about corporative success. In Machine Learning, 1995, a description of evolution leadership and technological development like main factors of productivity, with results more than satisfactory (neural network learning) when the projects are realized with a deep professional feeling and scruple, example of this can be found in J. T. Shipmann, 1992, when he states that the handling of science must be done with extreme accuracy in their measurement systems , avoiding misrepresented data already measured. Scientific precision accepts the inconvenience of the inefficiency and the high cost of transformation of complex processes into simplified technology , in order to have manufacturing plants with high productivity , Hammer Michael , 1993. The non-conformance with the statement mentioned lines above forced to the 61% of the manufacturing enterprises to disappear in the world between 1986 and 1991 (Manufacturing World Wide, 1995) and also was cause of firing of 47.39% of workers of manufacturing processes , Arsen J. Darnay, 1995. By those days, in Mexico were observed high standards of efficiency in the goods manufactured for exportation , which in percentage numbers of billions of dollars had an increment of 104.4% ; contrasting with the 17.47% worldwide, 39.78 in Canada and 23.54 in U.S.A., besides in this period Mexico obtained a 113.13% output from employees, 35.04 in Canada and 29.10 in U.S.A. , Doing Business in Mexico, Price Waterhouse, 1995.

Whatever analysis on productivity take us to understand that the manufacturing perfectionism can be achieves through the improvement in the quality of the products, optimizing the development and flexibility of processes in plants, and the appropriate usage of state of the art technologies , considering all the time the high risk in the operations and the superior knowledge known about manufacturing plants efficiency and the business in general T. K. Daas, 1999, these statements are directly related to the organization like an important issue for surviving against environmental demands each

time more turbulent and because of the continuos necessity for changing, without affecting retention , neither expansion of the legitimate values conforming the essence of its identity and image , in order to maintain it stable across the time Gioia, D, 2000. These were the principles for the improvement of quality control in manufacturing, in accordance with quality circles , "just in time" and Kan Ban from the beginnings of TQM; responsible for opening international competitively that later became the excellence of 6 Sigma, Michael D. Woods, 1994. Having operation failures have not let to some international plants in this region to certify in the international program of six sigma of quality control. Robert A. Peterson, 1992, confirmed the powerful association between the implementation of technological development and the manufacturing success of massive sales of products with plenty of acceptance by the customer; for Sidney J. Parnes, 1992, another factors to consider with no less importance are creativity , vision and opportunity , if somebody desires to be success . Yasuhiro Monden, 1995, conceptualize the success of the organizations by obtaining new markets with lowest cost possible in comparison with the competitors and he got it based on the smart balance of reductions supporting the optimum quality of the final product "Target Costing" that in same time legitimate the "Value Engineering".

William Davidow, 1992, recognizes inefficiencies into management of business and the deteriorate about dignifying the contemporary working class , in order to dignify the workplace and the worker achieve the optimum social equilibrium , the satisfactory evolution and development of the human race. The changes for the future need to be scheduled in order to achieve structural transformations for the world in the new millennium, with them come new leadership styles if the corporations desire to survive, Hesselbein, F, 1996 and Kouzes, M.J., 1995. You can not discuss about the future of manufacturing without mention the "Virtual product", that each day shows its high importance because its low cost, availability, massive reach, model variety and the capacity for covering everyday necessities, besides of its important feature of : " The perfect virtual product is not designed yet" , this is a huge reason in order to achieve its perfection.

Development.- The problematic situation expounded and the theoretical framework referred in synthetic way have been commented, besides of realizing interviews with high level directors of manufacturing plants, professors and academic people of ITR, let us to present the following hypothesis :

I.- Manufacturing Technology , optimization of its processes; the maximum extension of the working life , guarantee and the degree of acceptance of the products ; together with the level of education and labor instruction of working people are integral factors of productivity.

II.-It's very possible to establish differences between variables and the dimensions integrating each factor mark as priorities to the productivity in the manufacturing plants .

III.- Productivity can be identified in the multinational manufacturing plants like a function of optimal manufacturing and supported in the new technologies and management theories.

In order to show this hypothesis and the variables under study, we had to give dimensions to the knowledge level of the manufacturing productivity, and in a very special way the manufacturing plants in Reynosa, Tams, Mexico. With this dimensionality we developed a very sensitive instrument applied to manufacturing managers of 48 industrial plants in our region, conforming these, 24% of the plants installed in our region.

Results .- The data collected from our empiric test applied to the industrial sites under study, were treated under inferential statistics. The analysis of factors, show useful information respecting three of them like representative of the productivity, what you can identify like figure number one. The first of these orthogonal factors was denominated " Manufacturing Technology" and it was integrated with the following variables: Technology of manufacturing equipment, global technological level of the industrial plant, technology of the manufacturing systems and technology of the manufacturing devices. To the above mentioned was added the variable "monopolic function into the organization". The second factor was identified like " Optimization of the manufactured product", fundamentally related with usage life, guarantee and acceptance of the product. The variables conforming it are: Time of production, life utilization of product, spare parts, product cost, availability, optimization of product and of the system producing it. The third factor represented to " Efficiency and process optimization of manufacturing stations". It's variables were development of efficiency and also from optimization functions of the integrative units of manufacturing. Graphic number one shows the loads of the factorial coefficients, the eigenvalues, the Kayser-Meyer-Olkin test and the significance level, that show us that this is an useful test because the veracity concept for the identification of the variables and dimensions in the study. The variables and the dimension-concepts appearing in block number two of these results are very good examples of the before mentioned idea. Reliability test reported alpha standardized by average item of 0.91 and the significance of probability of 0.0001, this establishes the level of confidence about this instrument. Scaling test was also held giving 0.08 of stress test and RSQ of 0.97. Two specific dimensions were obtained in the Euclidian distances that show that highest productivity values are represented in the development for efficiency and for the optimization functions.

Discriminant analysis test was practiced for the variable " Optimization function of the manufacturing units", that gave us three useful discriminative functions. The first one showed a value of lambda's Wilks of 0.002; square chi of 240.3 and a level of significance of 0.0001, canonic correlation of 0.97; this discriminant function was integrated with the development for the efficiency in the industrial plants. The 98 percent of the industrial plants under study were very well classified. The second function of discrimination was associated with the manufacturing technology used on the equipment, transformation systems and processes used on the industrial plants, the value of lambda's Wilk was 0.04; square chi was 125.23 and the level of significance of 0.0001; canonic correlation of 0.95. The third function of discrimination was represented by "optimization of the manufactured product" that was related with manufacturing time, life and cost of product, integral optimization and availability of spare parts. Raw

materials like a dependent variable we practiced discriminant analysis and it gave us two useful functions; the first function presented lambda's Wilks` of 0.009; square chi of 188.3 and significance level of 0.0001; canonic correlation of 0.98. This discriminant function discrimination was integrated with the optimization function of the manufacturing units and with development for efficiency. The 96% of the industrial plants under this study presented high quantities of raw material disposed like scrap. The second function was presented through integrated manufacturing technology and technological level of system, also by the one of equipment and devices related to the manufacturing process, besides the monopolic function of the enterprise, the useful values for this function of discrimination were lambda's Wilks' of 0.28; square chi of 50.6, significance level of 0.0001; canonic correlation of 0.84.

Conclusions.- The studies about productivity shows us that this activity is regulated by the factor time and in a very special way about the time of programming of the production system, the installed manufacturing capacity , the work standards and the quality of the finished goods. This investigation teaches us through its first and second factor that first hypothesis stated in the study must be accepted because of the factorial structure featured by productivity, according with the obtained results, and the variables integrating itself. The affirmation made allow us to accept the second hypothesis because of the level of differentiation of the variables and the dimensions that manufacturing productivity showed like features. Also, this shows the importance that at this point has the level of technological advance that industrial plants applies. It is considered like an issue with deep importance the fact of finding the second factor denominated "Optimization of the manufactured product" in the plants under study, composed by the variables: useful life of product, guarantee and acceptance by the consumer. The variables integrating this factor were the average time of production, life time of the product, final cost, availability and spare parts useful life, integral optimization of the product and its manufacturing process.

The third factor represents the efficiency and the optimization of the manufacturing process. Its constitutive variables are the development of the efficiency and the function of the optimization of the manufacturing. The three factors together explain 84% of the phenomenon of productivity at industrial plants under study.

Into theoretical framework highlights how mechatronic and the development of the manufacturing technology eliminate factors and variables that in eighty's and ninety's were imperative of the productivity and show why now it needs people with high technological background in the industrial systems. In the future is ease to sight that technology will be the main variable of the manufacturing productivity.

The technology had the maximum vectorial value con 5.88 of eigenvalue and also explains the half of the phenomenon of productivity (53.5%). The variable monopoly activity was associated to technology because this always has to be vinculated at power in its maximum expression.

The second factor has an eigenvalue 2.25 and incrementing in 20.5% the knowledge of the phenomenon of productivity as a function of the usage life , the guarantee and the acceptance of the product, the low cost and the accessibility in order that the customer get answers; Edgar Garza Porras, 1997. Third factor only supports with ten percent the knowledge of productivity. Graphic number two makes an tridimensional integration of the three factors of productivity and settles the variables under study in a hierarchical position, what supports the demonstration found in the second hypothesis. High level of reliability was found in the application of the test to the escalar level for the variables under study , that can be confirmed with the test of Hotelling's T – squared of F, the level of significance levels probability and the alpha coefficients.

The discriminant analysis for variable "optimization function of the manufacturing units" in its first useful function, was found by "development for efficiency on industrial plants", the second function of discrimination was associated with the manufacturing technology; the third function was represented by the optimization of the product. The values found represent the enterprises with a better optimization of the useful life of the manufactured products, customers' guarantee and satisfactory acceptance of the general consumer. In the territorial map you can identify in the right superior quadrant the groups three and four that have the highest values of productivity and these represent the 50% of the enterprises interviewed. Group number one has the lowest values and it is twelve percent . The result of this analysis of discrimination shows the third hypothesis of this investigation. The discriminant analysis for the variable, scrap of raw materials, gave two useful functions, the first finished conformed with the variable of optimization of the manufacturing units and with the development for efficiency, the second was shown like manufacturing technology. All the industrial plants under study had great quantities of raw materials scrapped and also was observed that the forty percent of the enterprises with a high technological development also shown a high rate of scrapped raw material. The plants with a better optimization of the manufactured product and cost control showed the best scarp rate of raw materials. In the territorial map group number one shown a very high scrap rate and group number three did not show scrap .

With the results obtained in this investigation the academic authorities of the Instituto Tecnologico de Reynosa, proposed changes in the study plans for the industrial engineering career and also in business management career. In the first one, some themes and subjects were associated with re-engineering, concurrent engineering, CAD/CAM, CIM systems and the development of new manufacturing technologies, also, about the ties of the management systems with the computarized manufacturing. In the career of Business management the teaching subject were re-oriented under new concepts and alternatives of the strategic planning in the manufacturing function, the control and coordination of the optimization of the managerial process in the manufacturing , the handling of new leadership styles and the organizational conflict, besides of the application of a new ethic in the management and application of project development.

Like synthesis we can establish :

1.- Productivity can even be considered into the science of the management, like a theoretical entity referred to the concrete reality.

2.- In this investigation productivity is still shown with multifactor integration and with multidimensional structure.

3.- It is shown, that exists integration perfectly articulated between the manufacturing processes and the management functions, in correspondence to levels of technology , optimization of the manufactured product , and also to the efficiency of the manufacturing process.

4.- Functions and variables were identified of productivity into the areas of manufacturing and management.

5.- Technological development was highlighted like the most important factor and variable for the manufacturing and managerial integration.

6.- Very big rates of scrap in raw materials were found in the manufacturing processes of high technology , that directly affects the overall productivity in the industrial plants .

Summary .- This investigation shows the association existing between managerial variables and the ones from manufacturing processes in the phenomenon of productivity and settles the path to follow in order to know about the dimensionality of both.
The sample was composed by 48 industrial plants in the area of Reynosa in the state of Tamaulipas, Mexico. A perceptual instrument was applied for the measurement of the phenomenon under study. Validation for the instrument was held and its reliability was shown. Statistical tests were done through inferential calculus in order to demonstrate the relevant side of the phenomena. Results were presented and some comments were done respecting the link of the theoretical bodies.
Conclusion and Bibliography are also supplied.

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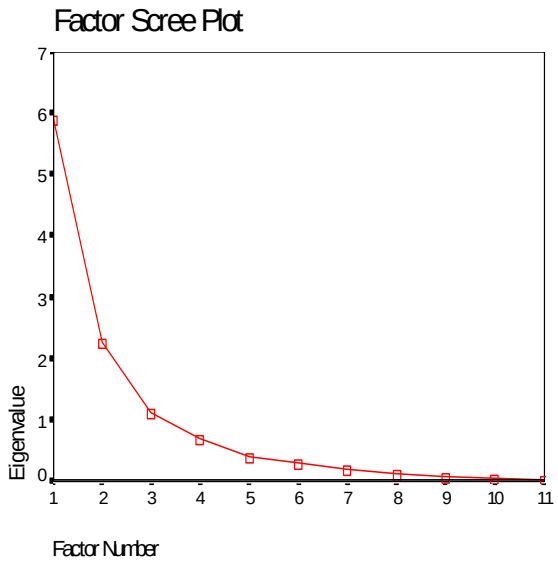

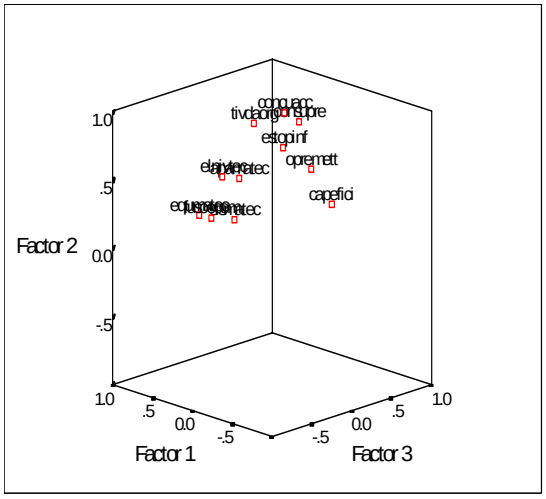

FIGURE 1

F A C T O R A N A L Y S I S

SCALE: MANUFACTURING PRODUCTIVITY n= 84

VARIABLES	F A C T O R S			COM	MEAN	S D
	I	II	III			
Tech. equip.	.96	.06	.04	.93	5.14	1.11
Monopoly F.	.85	.06	.08	.73	4.06	1.51
Tech. Level	.83	.34	.20	.83	4.20	1.44
Tech. System	.82	.00	.34	.78	4.40	1.26
Tech. Appliance	.76	.32	.34	.79	5.40	0.98
Production time	.10	.94	.26	.96	4.58	0.50
Life of product	.19	.90	-.04	.84	3.75	1.44
Product cost	.02	.86	.36	.87	4.63	0.49
Optimization prd/syst	.36	.58	.50	.71	4.75	0.44
Develop & efficiency	.17	.12	.92	.90	3.33	1.36
Function optimization	.30	.38	.80	.88	4.19	1.02

FACTOR	EINGENVALOR	PCT	PCT ACCUM
I	5.88	53.5	53.5
II	2.25	20.5	74.0
III	1.10	10.0	84.0

Kaiser-Meyer-Olkin MSA = 57.4

Bartlett Test of Sphericity = 632.17 Significance = 0.0001