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Research in the industry: Management model for production

Investigación en la industria: Modelo de gestión para la producción

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Abstract

This article called Research in the industry: management model for production shows the results on the application of a Knowledge Management Model focused on the development of scientific and technological research in companies through an adequate link Between the academy and the government .Within a taxonomy, the Knowledge Management Model used is classified in the "Technicians and Scientists" Because ITS design and is structured in eight phases, schematic results are presented for each one of them. The method used in the research was "applied research" from Which to qualitative-quantitative analysis of results emerges. Eight companies located in Jalisco state That Belong to high technology Sectors Considered as strategic in the areas of information and communication systems, electronics and aerospace Were selected.

Research, industry, application of a management model

Resumen

El presente artículo denominado Investigación en la industria: modelo de gestión para la producción tiene como objetivo mostrar los resultados sobre la aplicación de un Modelo de Gestión del Conocimiento enfocado al desarrollo de investigación científica y tecnológica en empresas mediante una adecuada vinculación entre la academia y el gobierno. Dentro de una taxonomía, el Modelo de Gestión del Conocimiento utilizado se clasifica en los "Técnicos y Científicos" y debido a que su diseño se encuentra estructurado en ocho fases se presentan resultados esquematizados para cada una de ellas. El método empleado en la investigación fue el de *investigación aplicada* del que se desprende un análisis de resultados cuali-cuantitativo. Se seleccionaron ocho empresas ubicadas en estado de Jalisco que pertenecen a sectores de alta tecnología considerados como estratégicos en las áreas de sistemas de información y comunicación, electrónica y aeroespacial. Los resultados obtenidos indican que es posible incrementar la producción científica y tecnológica e impactar en los indicadores internacionales, como el registro de patentes, mediante la aplicación de un modelo *ad hoc* para las empresas.

Investigación, industria, aplicación del modelo de gestión

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Introduction

This paper presents the results obtained from the implementation of a Knowledge Management Model (MGC) for the development of skills in the proposed Romo (2015) (Romo-Gonzalez Villalobos-Alonzo, 2016) research area are presented. The model was applied in six companies according to the Industry Classification System North America (NAICS / ISIC Rev. 4) of the National Institute of Statistics and Geography (INEGI, 2013) belong to high-tech sectors.

NAICS / ISIC called the High Technology Companies (AT) as economic units that work in the Manufacturing subsectors with nomenclatures of 333 to 336; that "design, develop, and / or produce" (Ministry of Economy [SE], 2013) in the electrical, electronics industries, auto parts, automotive, aeronautical and mechanical equipment.

In this classification, also considered companies Services technology in categories 62 and 63 of the National Classification of Economic Activities (NCEA, 2009), on programming, consulting, information services and other activities related to computer.

The application of MGC is crucial for the importance of technology companies in the economy of a country, its impact on Gross Domestic Product (GDP) is derived from its scientific and technological production, as royalties from intellectual property registry. The MGC applied is focused on developing research skills and consists of eight cyclical phases called:

1. Auto diagnosis
2. Training
3. Project Selection
4. Equipment integration
5. Project development
6. Information and dissemination
7. Analysis skills and
8. Skills transfer.

Self-diagnosis is systemized (Romo, Villalobos and Marquez, 2016A) and identifies the skill level of intellectual capital of enterprises; is divided into six domains that training needs arising prior training or the selection of projects through collaborative teams.

Production, derived from the project development is recorded for later broadcast and dissemination; and finally, an analysis of skills enabling its transfer to the human capital that can be integrated into new projects is made.

Although companies should focus on meeting the needs of customers, generating knowledge that enables innovation has become indispensable to maintain business competitiveness, so the systematization of these processes through a management model is relevant.

The results of the model application in companies are presented schematically for the eight phases constituent and is quali-quantitative manner, to address, herein methodological case centered method "applied research" is first described and then point scheme for data analysis is discussed.

Description of the method

The method used was that of applied research eight high-tech companies in the state of Jalisco were selected, the sectors that are taken into account are based on government policies governing the budget to maintain sustained economic growth in Mexico. Policies are identified in section III.2 of the National Development Plan (PND, 2013, p. 68), where the priority of "doing scientific, technological and innovation development pillars is summarized progress in its goal 3.5, economic and social sustainable ".

From the definition of the strategies in the 2014-2018 PECITI priority topics are grouped in Science, Technology and Innovation 7 relevant areas (CONACYT, 2014, p. 51): environment, knowledge of the universe, sustainable development, energy, health, technological development and society.

However, are the last two issues: technological development and society, listed as being those that affect the Balance of Payments Technology (BPT). Therefore, the sectors related to information and communications technology, electronics manufacturing plants for the production of light and heavy vehicles and aerospace are contemplated.

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Once the sectors identified extracted base OneSourse data (Avention, 2014), the list of companies in the state of Jalisco, the filters applied are made based on industry classification ISIC (Revision 4) which were obtained distributions presented in Table 1.

AT sectors	Number of companies
Technology of the information and communication	fifty
electronic manufacturing	121
Automotive / Manufacturing	69
Aerospace	two
Total	**242**

Table 1 Ratio of number of companies by sectors of AT in the state of Jalisco
Source: Self Made

It is considered a time of application of MGC a year in eight companies taking two for each of the sectors identified in Table 1. The total human capital participating in the study is 35 people. For phase one implementation of the MGC an instrument validated in terms of criteria, content and construct with IP registration is used (Romo et al., 2016b).

The instrument called "self-diagnostic system for assessing research skills" consists of 50 reagents and assesses six domains of competence on a Likert scale from 0 to 4 that a maximum of 200 points is clear.

Analysis

The definition of measuring scale allows you to set the type of statistical analysis that will be used for variables and indicators. However, because the structure of MGC was already validated correlation statistics, in this section the analysis scheme resulting from the application of the model in its various stages shown. Quantitative analysis information is based mostly on descriptive statistics and a qualitative report for each phase is summarized in Table 2.

Phase	Analysis
1. Self-diagnosis	Statistics on the application of 35 Self-diagnostics in 6 competence domains (Romo, Villalobos and Marquez, 2016b). qualitative summary of the results of self
2. Training	Statistics on training levels and their relationship to the domains of competence. Plans defining general and specific training in the areas of opportunity detected in self-diagnosis
3. Selection of projects	Statistics on the definition of high-impact projects and social benefit analysis and access to state and federal calls.
4. Integration of equipment and	Statistics on the signing of agreements and definition of collaborative programs with advice, Chambers and educational institutions.
5. Project development	Statistics on the definition of research protocols, obtaining financing, sessions and workshops.
6. Diffusion and dissemination	Statistics generated scientific products as well as dissemination and outreach mechanisms used.
7. Analysis of skills and 8. Transfer of skills	Evaluation of results of project development and its correlation with the variables on the results of self-diagnosis. Descriptive analysis Stays scheme linked to external entities.

Table 2 Summary of results for analysis on the model application management knowledge.
Source: Self Made

Given that each of the stages require different management strategies for the application considered relevant descriptive statistics for the final report of the results.

Results

The application of the eight phases of the model yielded results that started from obtaining human capital profile with self-diagnostic research skills. As a starting point a set of research competition are based on the profile of the researchers for the type of high-tech companies that were selected in the method defined. The results of applying the entire model are presented diagrammatically in Figure 1.

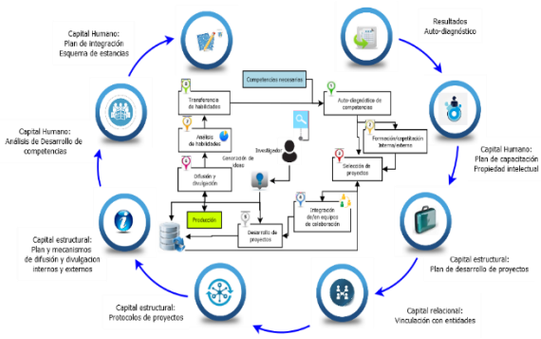

Figure 1 Outlining results of applying knowledge management model for research competence
Source: Romo (2015)

For subsequent phases (from 2 through 8) show the results with approaches to human capital, structural capital and relational.

On the results of the implementation of step 1 called self-diagnosis, a measuring instrument with the human capital approach we were used. The results of self-diagnosis allowed to define a training plan for training in the area of research, intellectual property rights, patent registration, generation of technical reports and publishing articles.

With regard to the application of step 2, the training was conducted by an external area businesses and consulting for the definition and selection of projects was provided.

As part of this strategy, Phase 2, a proposal for participation for obtaining National Register of Institutions and Scientific and Technological Enterprises (RENIECYT) was established.

Systematization dynamics of this process allows the generation and accumulation of knowledge. Implementing steps 3 and 4 was carried out with a focus on strengthening the structural and relational capital, high-impact projects that were selected Briden social benefits. linkage programs with external entities defined as Councils, Chambers and State Higher Education Institutions with which collaboration agreements framed in the policies of the enterprises and institutions were signed.

In the initial application of step 5 protocols defining projects that allowed detailing the characteristics of the research to be undertaken and obtaining financing for its implementation was structured. In step 6 a summary report to establish internal mechanisms of diffusion and dissemination starting with an electronic bulletin board where also an internal call in which he was urged to provide project ideas for innovations and improvements that are recorded in the database was established plan defined organizational data.

Registration databases allowed to define integration schemes in projects and stays scheme linked to external entities. For the analysis of skills step 7 was agreed to apply the self-diagnostic skills to complete projects.

The summary of the inputs and outputs for each phase to obtain results shown in Table 3.

Phase	Entry	Exit
one	Competencies needed for research in six domains	Researcher Profile
two	Researcher Profile	Training plans
3	Researcher Profile	Definition and selection of projects
4	Researcher Profile Research projects	Linkage programs, collaboration agreements, collaborative teams
5	Collaborative teams	Protocols Project scientific and technological production Project Portfolio
6	Project Portfolio	Plans and internal and external mechanisms for melting and spreading of projects.
7 and 8	Project Portfolio	Evaluation of results, application self-diagnosis

Table 3 List of inputs and outputs on results of applying MGC
Source: Self Made

Ranges interpretation of self-diagnosis is set according to the distribution of Table 4.

Rank	Interpretation
0-40	Undeveloped
41-80	Minimum
81-120	Regular
121-160	Good
161-200	High

Table 4 Ranges for the interpretation of data from Phase 1
Source: Prepared

The overall statistical analysis of the eight companies on the results of self-diagnosis of the 35 participants is presented in Table 5.

Phase 1 results		
Investigativa competition	**general**	**Interpretation**
I. methodological domain	25.83 / 60	Regular
II. Project management	14/28	Good
III. technological expertise	23/28	High
IV. Finding Information	14/28	Good
V. Oral communication in the research area	17/28	Good
SAW. Written communication in the area of research	12/20	Minimum

Table 5 Relationship of overall scores for competence domains for research development of Phase 1 MGC
Source: Self Made

In addition to the information presented in Table 5 minimum, maximum and overall averages were calculated whose general interpretation indicated that participants in the study have a level of research skills identified as: Regular.

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The domain greatest weaknesses is the interpretation of a minimum, so it can be inferred that as a result of this issue no records of patents or intellectual property are made "written for the research area Communication".

Other domains that should be strengthened is the Sourcebook as it is in the range of regulating and presents major problems in the method specification. The results of self-diagnosis possible to focus the phase 2 in strengthening human capital and amounts shown in Table 6 were obtained.

Phase 2 results	
Result	**Quantity**
overall training plan	8
customized plans	31
external training (research and intellectual property).	8
Consultancy for the definition and selection of projects	9
Obtaining the National Register of Institutions and Scientific and Technological Enterprises (RENIECYT)	6

Table 6 List of results obtained in Phase 2 "Training / Training" MGC
Source: Self Made

General training plans were defined in collaboration with the Human Resources and 31 customized plans representing 88.5% of participants in the study were conducted.

It is noteworthy that one of the eight participating companies already had the RENIECyT, but six managed to obtain it.

Obtaining registration provides an opportunity for participation and access of companies in various federal funds, they open workspaces with adequate links with academia, society and various government entities.

With regard to Phase 3 "Project selection" was to strengthen the structural capital through the definition of high-impact projects that provide social benefits, its definition was supported by internal and external consultants specialized in strategic sectors they belong the companies. Phase 4 was in focus on strengthening the relational capital, the data obtained are summarized in Table 7.

Phase 4 results	
Result	**Quantity**
Definition of linkage programs with external entities (Councils, Chambers and State Higher Education Institutions)	8
Signing cooperation agreements framed in the policies of the companies and institutions.	twenty-one
external training.	5
Integration of collaborative teams.	9

Table 7 Summary of results obtained in Phase 4 "Integrating collaborative teams" of MGC
Source: Self Made

After defining training plans or training viable projects through access to calls for projects and funds are determined. Once established projects work teams and internal and external collaborators were established, cooperation agreements were signed based on the policies of the institutions involved. Phase 5 is focused on strengthening the structural capital obtaining data in Table 8.

Results Phase 5	
Result	**Quantity**
Protocols projects based on the characteristics of the investigations.	9
Application calls.	6
Obtaining financing	4
Working sessions and seminars	46

Table 8 Summary of results obtained in Phase 5 "Project development" of MGC
Source: Self Made

Specification defining projects and teams with capabilities for ensuring the project goals ensure timely completion and obtaining quality products. Generation of products developed by collaborative teams strengthens relational capital and contributes to the completion of projects by having access to government funds. Therefore, Phase 6 focused on structural capital getting the results presented in Table 9.

Results Phase 6	
Result	**Quantity**
Summary internal mechanisms of diffusion and dissemination plan	8
e-newsletter.	5
Internal call (bring project ideas for innovations and improvements). Working sessions and seminars	7
Production recorded in the database of organizations.	24
Business update page to add R & D + i	5

Table 9 Summary of results obtained in Phase 6 "Dissemination and outreach" of the MGC
Source: Self Made

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Products generated can be disseminated internally and externally through various mechanisms, diffusion allows internal staff there that adds to human capital of the organization working in research and technological development.

The advantages mentioned processes the information and dissemination in priority areas attract experts from external institutions adds.

The final stages (7 and 8) are focused on the analysis of developed skills and transferring by cyclic application model so that focus on strengthening the human capital, in Table 10 the results are presented.

Results Phase 7 and 8	
Result	**Quantity**
Evaluation of results of project development.	9
Application of self-diagnosis.	35
Stays scheme linked to external entities.	4

Table 10 Summary of results obtained in Phase 7 and 8 "Analysis of skills" and "skills transfer" of MGC
Source: Self Made

For analysis of skills Phase 7, upon completion of the project it was again self-diagnosis applied exclusively to human capital that participated in the initial equipment and a comparative analysis of the results is carried out.

This analysis identified the percentage in improving skills to develop research and produce quality products that impact on international indicators to measure producing countries as the indicator of registration of patents, utility models, royalties, copyright or bibliometric on the percentage of citations to published articles.

The analysis of the data in the application of self-diagnosis showed that participants have strength in the technological domain. However, those relating to the powers of the methodological domain and written communication areas for the publication of research results and scores were low percentages obtained. The proper definition of the profile allowed researchers to establish a general training plan and customized plans.

Defined the profile of the researcher was able to establish a portfolio of projects and protocols for obtaining financing through the application calls for federal and state funding, strengthening structural capital when defining a project development plan. The application calls for obtaining state funds was reinforced through engagement and collaboration of companies with Higher Education Institutions (IES) and Collaborating Institutions (IC), whose working sessions and seminars generated and captured ideas.

Among the objectives of the definition of protocols of research projects are increasing the powers of the methodological domain because the requested guidelines are based on formal structures for its definition, which also helps to develop skills in technological domains and search for information.

It is expected to obtain external financing, as well as allowing the development of high-impact projects generated by companies in connection with society, strengthen leadership skills and planning of human and financial resources and identified as factors influencing in scientific and technological production.

Within the information and dissemination plan an internal bulletin in each of the companies in which the objectives of the proposed projects were detailed designed. The intention of opening the electronic bulletin as communication space was divided into two tracks, the first focused on strengthening the skills of written communication and the second towards generating ideas.

To develop the skills of oral and post internal diffusion of communication projects, internal and external seminars were planned (with IES and IC) for advances presentation and synthesis of results; and the integration of proposals for presentation at conferences with adherence to the privacy policies of the company.

As a result of the link between the various sectors they collaborated Program stays of business research that allowed researchers to integrate higher education institutions and students in the company for intermittent periods of between four and eight months was established.

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To systematize the process of implementing the model and measure the results on the test model was designed implementation of a database monitoring and control of knowledge management focused on research skills.

Conclusions

During the implementation of Knowledge Management Model it was identified that the creation of protocols for research projects increases the powers of the methodological, technological and information search domain.

Competencies identified are considered indispensable for knowledge generation and technology development.

Obtaining external financing, as well as allowing project development strengthens leadership skills and planning of human and financial resources as they are factors that affect the scientific and technological production.

The internal bulletin as dissemination and outreach strategy, focuses on strengthening the skills of written communication and idea generation.

Internal and external seminars (with IES and IC) for advances presentation and synthesis of results; and the integration of proposals for presentation at conferences with adherence to the privacy policies of companies contribute to the development of oral communication skills.

Programs stays allow researchers to integrate higher education institutions and encourage early research, so that the application of management models focused on research knowledge is feasible for companies and allows them to increase production.

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