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Faculty of Economics and Business Administration
Doctoral School

DOCTORAL THESIS SUMMERY

EXPECTATIONS GAP BETWEEN HIGH-TECH INDUSTRY MANAGERS' REQUIREMENTS AND THEIR EMPLOYEES' AQUIRED KNOWLEDGE

Scientific Coordinator : **Professor Dr. Ilies Liviu**

Doctoral Student **: Harry Tzvi Sender**

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Chapter 1: INTRODUCTION

1.1 RESEARCH TOPIC RATIONAL

1.1.1 INTRODUCTION

High-Tech Companies operate in a most competitive environment, considering the complexity of the global markets and the ***knowledge-intensive demands*** in the context of their Research and Development (R&D) extensive activity. Setting the ultimate goal of long-term success, innovation is considered the main parameter which reflects on the necessity for scientific and technological leadership.

This thesis is based on a comprehensive qualitative research, based on in depth Multiple Cases Study (MCS). The empirical research focused on a variety of HT companies in Israel, which represent a large spectrum in terms of scientific disciplines, products, markets and structure. Considering the nature of the HT industry in Israel, the results of the research are expected to be applicable in a large scale, beyond the geographical boundaries.

The research will introduce the problem of ***'Expectation Gap between Managers' Requirements and Employees' Acquired Knowledge'*** with considerable influence on the quality of the R&D process in general and to 'Knowledge Management' (KM) in particular. The research will address the given problem using in depth interviews with senior R&D managers with focus on a genuine 'Knowledge Oriented Taxonomy'. The research will demonstrate the actual mapping of the 'Extra Disciplinary Gap' with the practical implication on strategic policies in general and employee evaluation and management in particular**.**

Note: The research will be addressed as the **Main Research** (**MR**) for improved readability of the text.

1.1.2 MAIN RESEARCH DEFINITION

The topic of the Main Research (MR) is defined as follows:

The gap in expectations between the High-Tech Industry Managers' requirements and their Employees' acquired extra disciplinary knowledge.

The MR is based on an observation that there is a ***substantial gap*** between HT Managers' requirements and their employees' acquired knowledge. This observation is a result of my personal experience of over 30 years in the HT Electronics Industry in R&D leading positions of multidisciplinary computer based

systems. The hypothesis is based on the well-known fact that HT Companies rely *substantially* on their ability to maintain an efficient, original and creative Research and Development process. The introduced research will focus on 'Extra Disciplinary' knowledge and will be addressed for simplicity as the **'Performance Oriented Extra Disciplinary Knowledge' Managerial Expectations Gape'** (It should be noted again that in most cases, the ***MR Topic*** will be mentioned in short as the **'Managerial Expectations Gape'** (**MEG**), mainly for achieving an improved readability of the text)**.**

A fundamental literature review has been conducted to establish a solid ground to the **MR**. The literature review revealed a significant number of management oriented disciplines and models which correspond to the objectives of the MR. The literature produces ample knowledge regarding 'Knowledge Management' and 'Performance Management'. However, within the ***context*** of the **gap** between 'Managers' Expectations' and 'Employees' Performance', **no knowledge** was found about performance related to knowledge (**!**).The MR has the potential of establishing an original fundamental understanding of the mentioned problem, with practical management tools for mapping and potentially reducing the MEG in the R&D environment.

1.1.3 BACKGROUND CONSIDERATIONS

As mentioned earlier, the HT industry is a competitive environment – Managers in this sector are under constant pressure to maintain considerable revenue for the firm. In the modern markets, the activity of the organization is based on a strategy which must address two main key issues:

a. Definition of a R&D plan is based in most cases, mainly on the Marketing Strategy.
b. Management Strategy concerning personnel – this is a critical challenge which involves HRM strategies, Knowledge Management, Performance Management, Talent Management methods and other 'Human Capital' oriented issues.

In the context of the MR, the **overall performance ability** of the employee is considered the main area of interest. The focus will be ***only*** on knowledge oriented skills rather than **psychological** issues.
The MR will focus on performance related skills which are **beyond** 'Discipline Oriented Knowledge' (e.g. Physics, Chemistry, Biology, Mathematics, Electronics Engineering, Computer Engineering, Computer Sciences, Mechanical Engineering, Avironautics Engineering etc.), defined as **'Extra Disciplinary Knowledge'**.

1.2 RESEARCH OBJECTIVES

The MR will focus on performance related skills of **employees**. The R&D process is considered to be very complicated – the actual incorporation of **Top-Down** and **Bottom-Up** techniques requires special skills which are ***beyond*** 'Discipline Oriented Knowledge'. Therefore it should be evident that the MR

deals with very important issues concerning the **'Long Term Strategy'** of the firm. The Hypothesis in the context of the MR is based on the fact that the MEG problem is well recognized in the HT industry, with emphasis on the R&D environment:

Hypothesis – ***The MEG problem is a critical problem in the R&D environment from the firm's comprehensive strategy perspective.***

RQ1 – Main Research Question

Based on the above Hypothesis, the ***main*** Research Question arises. It should be noted that RQ1 represents an attempt to explore the MEG problem from a new and in-depth perspective, in order to gain reliable knowledge, not yet established in previous research activity. RQ1 is defined as follows:

RQ1- ***What are the characteristics of the MEG problem?***

Secondary Research Questions

In the context of the MR, the empirical research will address several issues which are considered the secondary research questions:

a. **RQ2 –** ***What are the R&D Managers' constrains?***

The research will detect the main parameters which affect the performance related requirements forced by the objective surrounding' parameters and the senior management's imposed objectives.

b. **RQ3 –** ***What are the R&D Managers' performance expectations from their employees?***

The research is expected to demonstrate a common set of requirements from the personnel, which are considered a **must** in the working environment which is mainly R&D oriented.

c. **RQ4 –** ***What is the profile of the "Ideal Employee"?***

The actual "Mapping" of managers' expectations will be used in this research to define the profile of the **'Ideal Employee'**. This definition can be practical for the recruiting process and especially for employees' performance appraisals, compensation and benefits, as part of the HRM activity.

d. **RQ5 -** ***How employees are evaluated in relation to the MEG characteristics?***

The empirical research will demonstrate the actual evaluation methods and "Habits" used by managers within ten (10) different case studies.

e. **RQ6 -** ***How employees' evaluations affect managerial decisions in the R&D environment?***

The empirical research will explore the various managerial decisions such as Job assignment, recruitment, appraisals etc.

f. RQ7 – *What are the implications of the MEG problem on the general strategy of the firm?*

The MR will address the general strategy assessment related to the MEG status in a given company – the idea is to demonstrate the linkage between R&D problems to Marketing strategy, competitiveness etc.

1.3 RESEARCH LIMITS AND BOUNDARIES

The **MR** was conducted in **Israel** and therefore it focused on HT Companies in Israel. Main research boundaries are defined by the following parameters:

1. **Geographical Boundaries** – the research was conducted in **Israel** only. However, taking in account the special nature of the HT Industry in Israel, the results and conclusion of this research will be relevant in a broader scale.

2. **Performance Related Skills** – The research considered knowledge and skills which affect performance directly. The 'Discipline Oriented Knowledge' (DOK), was excluded being the **obvious requirement** for a given job. However, facing the challenge of distinguishing between 'Disciplinary Knowledge' and 'Extra Disciplinary Knowledge' (EDK), a comprehensive 'Knowledge Oriented Taxonomy' will be introduced.

3. **Industry Characteristics** – The research focused *only* on **HT companies**. This sector is considered most relevant because the R&D process is the main activity. A successful R&D operation requires high level of performance which in this case is very much "knowledge related" in a broader perspective.

4. **Employees' Qualities** – The main research is restricted to **practical/objective** qualities which are tied to performance with distinct focus on Extra Disciplinary Knowledge Oriented skills. Following this perspective, the research **did not** address employees' requirements regarding personality or psychological attitude. As a matter of fact, the MR assumes the ***most qualified employees*** from the psychological point of view. In practice this approach prevented possible *ambiguity* during the "Field Study" and reduced to minimum the *deviations* in the Raw Data' interpretation.

5. **Main Research Discipline** – The MR focused on **Business Management** issues and ***did not*** study the aspects of its results in other disciplines (e.g. Education at various levels, Brain Research, Artificial Intelligence (AI) Research etc.). The MR made it possible to recommend

and ***justify***, **future research activity** in other disciplines with the objective of reducing the 'Managerial Expectation Gape' in a more comprehensive context.

6. **R&D Considerations** – The R&D process in the HT industry and HT oriented Research Institutes, is affected by the nature of the actual product, service or technology objectives. The MR focused on the ***common parameters*** which correspond to the 'Managerial Expectation Gap'.

1.4 RESEARCH ETHICS

MR focus on the mentioned MEG' problem, is considered very sensitive due to the strong relations to firm's ***actual*** strategy in general and the crucial knowledge related issues. The actual efforts to achieve technological 'state of the art' knowledge, has a significant influence on KM tactics and specific employees' management practices. In fact there are important differences between the "formal management values" and the actual management objectives. Considering the vital importance of the "Human Capital", it was ***essential*** to set the adequate "Atmosphere" so that the interviewees will be confident to express their views freely.

In the context of the Interviews during the empirical research, I made considerable efforts to establish a mutual understanding and trust reassuring the interviewees a complete confidentiality. Following the above ethics, the names of the companies and the interviewees were maintained anonymous. Furthermore the actual introduction of each company was minimal with special care not to reveal the company's identity.

Chapter 2: LITERATURE REVIEW

The Literature Review is considered the theoretical part of the MR. The main objective was to perform a comprehensive exploration of the leading scholars' opinion regarding the key issues related to the MR.

In practice the focus was on five (5) disciplines which are considered most relevant to the MR:

1. Human Resource Management (HRM).
2. Knowledge Management (KM) with focus on KM in HT Companies.
3. Employees' Evaluation Methods.
4. Marketing.
5. Economic Integration and Globalization.

The Literature Review (LR) established a solid theoretical foundation to the Empirical Research. However it should be noted that a detailed description of the LR is beyond the context of this Thesis Summery. The reader is advised to address **Part II** in the Thesis.

Chapter 3: METHODOLOGY

3.1 MR RESEARCH METHODE

The Empirical Research was conducted using a 'Qualitative Multiple Case Studies Research'. In practice ten (10) cases were explored, conducting ten in-depth interviews with senior R&D Managers in ten different HT companies in Israel.

In the context of this summery only a brief justification of the MR Methodology will be introduced (A comprehensive justification is given in Part III of the thesis).

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A 'Case Study' is an empirical inquiry that investigates a contemporary phenomenon within its real life context especially when the boundaries between phenomenon and context cannot be drawn clearly or unambiguously. In the context of this chapter the methodology of 'Qualitative Case Studies' only will be addressed.

Like any other method, case studies also have both strengths and weaknesses. Case studies are quite often used in the area of international business (IB), and they are appropriate for several purposes, including theory generation, exploration, testing, refutation, refining, and prediction. The case study method can be applied in small countries and new topic areas, for studying complex phenomena and incremental processes, answering "how" and "why (not)" questions. This method allows collecting additional data at any time, and using different additional sources like newspapers, annual reports, and corporate homepages. Thus, compared to some other methods - for example, surveys - case studies have several advantages.

3.1.1 CASE STUDIES ADVANTAGES

1. Case study research is a very useful method as it allows ***expanding and generalizing theories*** by combining the existing theoretical knowledge with new empirical insights (Yin, in Vissak 2010). This is especially important in studying topics that have not attracted much previous research attention.
2. The research subject is in a field which the terms and definitions are not established in a large scale and are not based on a known accepted theory.
3. Case studies are especially helpful for discovery, description, mapping and relationship building, but they may also be used for theory testing, refutation, refining (Gummesson, in Vissak 2010).
4. Case studies do not necessarily have to rely on previous literature or prior empirical evidence. Thus, case study research can be used for theory-building even if little is known about the

phenomenon. Moreover, this method is appropriate when current perspectives seem inadequate, if they conflict with each other or even if they contradict with current research (Eisenhardt, in Vissak 2010).

5. Case research can help to discover causal relationships (Hillebrand; Kok & Biemans; Jensen & Rodgers in Vissak 2010).
6. Case research helps to understand how and why everything has happened in a certain way (Yin**,** in Vissak 2010).
7. Case research creates thick, interesting, and easily readable descriptions and rich understandings of how and why everything has happened in a certain way (Yin, in Vissak 2010).
8. Case studies can be also used for deeply investigating dynamic, experiential and complex processes and areas (Halinen & Törnroos, in Vissak 2010).
9. Case studies allow the necessary data to be collected over a long time period (Miles & Huberman, in Vissak 2010).
10. The case study method also enables research to be conducted in countries with sample bases too small for using statistical generalization (Chetty ; Daniels & Cannice, in Vissak 2010).

3.1.2 CASE STUDIES CRITIQUE

1. Case Studies are usually more time-consuming and labor-intensive than survey methods (Daniels & Cannice, in Vissak 2010).
2. In studying complex processes, different researchers are unlikely to observe the same set of events - the same configuration of people, groups, social relationships, technologies, and so on. Therefore it is very complicated to replicate the results of case studies.
3. Case studies' descriptions may be too long in cases where the volume of data is overwhelming and might result with descriptions which are out of focus (Halinen & Törnroos, in Vissak 2010).
4. Interviews may be affected by time constraints, interruptions, the presence of third parties monitoring the discussion, sudden crises facing the company which distract the interviewee, and several other factors (Welch, in Vissak 2010).
5. Single case studies limit the ability to generalize from the conclusions, models or theory developed from the selected case (Eisenhardt & Graebner, in Vissak 2010).

Due to the above-mentioned weaknesses (and prejudices), qualitative methods, including case studies, have sometimes been characterized as soft, descriptive, "feminine," "microscopic," less concrete/precise/objective/rigorous, unsystematic and "second best". However, following the opinion of most scholars, it can be argued that the strengths of the case study method outweigh its weaknesses, especially when the strategy of 'Multiple Case Studies' (MCS) is adopted.

3.1.3 MULTIPLE CASE STUDIES STRATEGY

Multiple Case Studies Strategy (MCS) was chosen for the MR . In practice the empirical research included ten (10) case studies which are considered to accomplish a well solid research considering the general accepted range of 4 to 10 cases (Eisenhardt, in Vissak 2010). In the context of the MR the MCS strategy is justified as follows:

1. Diversities in Company's products/systems which belong to different markets.
2. Different disciplines at the macro level (e.g. Hardware, Software, Computer Based Sytems, Optics, Chemistry, Biology etc.).
3. Different R&D implementation styles (R&D is not a rigid structural process!!!).
4. Different Companies from the structure point of view, such as MNCs, Subsidiaries or Domestic medium size Companies.

It should be evident at this point that the advantages of case studies in general and MCS in particular, establish a strong foundation for the 'Empirical Research'.

3.2 POPULATION

The sample population was established with direct correlation to MR objectives and boundaries as follows:

1. HT companies only – assuming the gravity of the MEG problem especially in the R&D environment and the consequences regarding firms' comprehensive strategy.
2. Companies in Israel with strong relation to countries (Cultures) abroad – focus on MNCs with subsidiaries around the globe. This approach increases the MR relevance in a broader geographical scale, outside Israel.
3. Broad Spectrum of macro level disciplines, technologies and products – The main objective is to achieve, high quality information and knowledge as comprehensive as possible during the actual Empirical Research. The ultimate goal was to support a solid and valid data analysis process.
4. Senior R&D managers as Interviewees – this most distinguished group was chosen for two main reasons:

a. They are considered experts in all the issues which are at the focus of the MR. This corresponds to the basic requirement in qualitative studies.
b. They belong to the senior management group in the company and have a good understanding of the **real** company's business strategy.

Table 3.1 includes the integrated information regarding all the ten companies included in the empirical research. It should be noted that this group of companies, represent a wide spectrum in terms of the parameters which were considered during the design of the empirical research. Therefore the information gathered during the interviews, is expected to support a solid ground for the empirical research and the actual methodology.

Case No.	Company Structure	Israeli Brunch	GP	Macro Level Discipline	MDS	Product Type	Markets Range
1	**MNC**	Headquarters	X	Hwr&Swr	X	M&C Systems	International Markets
2	**MNC**	Headquarters	---	Hwr&Swr	X	Laser Systems	International Markets
3	**MNC**	Subsidiary	---	Hardware	X	Semiconductors	International Markets
4	**MNC**	Headquarters	X	Software	---	Billing & Customer care	International Markets
5	**MNC**	Headquarters	---	Chemistry & Biology	---	Medicines	International Markets
6	---	Independent Company	X	Hwr&Swr	---	Data Communication	International Markets
7	---	Independent Company	X	Hwr&Swr	---	Data Communication & Semiconducters	International Markets
8	---	Independent Company	X	Software	---	Business & Network Support Systems	International Markets
9	**MNC**	Subsidiary	---	Hwr&Swr	X	IC Production & Test Equipment	International Markets
10	---	Independent Company	---	Chemistry	---	Agriculture & Veterinarian Chemical Preparations	International Markets

M Systems – Military Systems
C Systems – Commercial Systems
MDS – Multi Disciplinary Systems
MNC – Multi National Company

GP – Global Partnerships
Hwr – Hardware (Electronics Circuits)
Swr – Software (Computer Oriented Programs)
IC – Integrated Circuits (semiconductors)

Table 3.1 – Companies Profile Summary

3.3 INTERVIEWS STRUCTURE

The following MCSR was based on 'semi-structured Interviews' which designed to collect qualitative information from a small sized sample. This approach is justified taking in consideration the MR which is based on ten case studies following the 'Qualitative Research' method. In the context of the empirical research, it was assumed that the respondent (Interviewee) has a particular experience on which he can elaborate. In this study the interviewee was expected to have extensive knowledge and experience regarding the R&D environment with the perspective of management on R&D process and employees.

The interviews were conducted in the following stages:

1. **Introduction** – Interviewer (Me in this case) introduces himself, explains the purpose of the Interview, assures of confidentiality (very important!) and ask permission to make notes. In most cases the Interviewee responded by introducing himself, clarifying his precise position in the company.

2. **Warm Up** – Nonthreatening question: The Interviewee was kindly asked to respond freely, and give his ***general opinion*** addressing the MEG problem.

3. **Standardized open-ended interview** (Patton, in Berry 1999) – Ten open-ended questions were presented to the interviewee. The questions were carefully worded and arranged in order to minimize variations in the questions posed to other interviewees in the context of the MR.

The questions were presented as follows:

Q1: How you define the main performance constrains of the R&D Manager?
Q2: How you define the general R&D Manager' Expectations from his Employees' performance?
Q3: How you define the main Knowledge Management (KM) Problems?
Q4: How you define the main Knowledge Management principles and Strategy?
Q5: How you define the main Employee's Knowledge & Skills expectations of the R&D Manager?
Q6: How employees are evaluated by R&D managers?
Q7: How you define the Appraisal Strategy in your firm?
Q8: How HRM functions are implemented in your company?
Q9: How you define the Comprehensive Strategy?
Q10: How you define the main "On Target" performance expectations of the R&D Manager?

4. **Guided Interview** (Patton, in Berry 1999) – In this stage the 'Knowledge Oriented Taxonomy' (KOT) was introduced (refer to Section 3.4). The interviewee was asked to use the taxonomy for

describing his opinion in several key issues which are at the center of the empirical research. In practice, only the EDK components were consulted and the interviewee was asked to rank (quantify) each component according to the question at hand. The data was gathered in tables as follows:

	Extra Disciplinary Knowledge Taxonomy								
Index	7	8	9	10	11	12	13	14	15
Criterion	PDA	PSA	SLA	KIS	KOC	SKERD	AA	C	I
Value									

Table 3.2 – Guided interview Template

Five questions were presented:

Q11: The ***relevance*** of KOT's EDK criteria for the R&D environment (Scale of 1 to 5).

Q12: The ***relevance*** of KOT's EDK criteria for MEG description (Scale of 1 to 5).

Q13: The ***profile*** of the ***"Ideal Employee"*** assuming the R&D professional with no Management' position (Scale of 1 to 10).

Q14: The ***profile*** of the ***"Ideal System engineer"*** with the responsibility for functional System (or Product) specifications (Scale of 1 to 10).

Q15: The estimate of the ***gravity*** of the MEG problem from a general perspective, which actually defines the ***'Gap's General Profile'*** (Scale of 1 to 10).

5. **Closure** – At this stage the interviewer expresses his gratitude to the interviewee and sets the ground for future mutual communication. In most cases the interviewees expressed their will to receive the detailed description of the KOT and also receive the results of the MR in the future. In some cases they expressed their will to provide additional information regarding their company which in most cases was very useful.

3.4 KNOWLEDGE ORIENTED TAXONOMY

The following Taxonomy refers to both 'Discipline Oriented Knowledge' (**DOK**) and 'Extra Disciplinary Knowledge' (**EDK**). This Taxonomy is intended to serve as a tool for disclosing the different types of knowledge and their ***effect*** on performance. Furthermore, this Taxonomy is expected to formulate the fundamental differences between **DOK** and **EDK**.

In the context of the empirical research, the given taxonomy will serve as the source of criteria for exploring the MEG problem. My taxonomy introduces fifteen (15) Knowledge and Skills Parameters.

3.4.1 DISCIPLINE ORIENTED KNOWLEDGE

1) Theoretical Discipline Oriented Knowledge (TDOK)

TDOK represents Discipline Oriented knowledge (e.g. Physics, Chemistry, Biology, Materials Science, Electronics Engineering, Computer Engineering and Mechanical Engineering) which is acquired by formal education and self study.

2) Practical Discipline Oriented Knowledge (PDOK)

The portion of TDOK which is based ***only*** on *Empirical Experience*. PDOK represents the acquired knowledge in the practical innovation process which at best results with new 'state of the art' knowledge.

3) System Engineering Multidisciplinary Knowledge (SEMK)

System oriented Knowledge (Functional-Based Knowledge) in a significant variety of subject matters. This type of knowledge is possessed by professionals with considerable experience in R&D of multidisciplinary systems or a variety of systems of different disciplines. System Engineering ability is largely viewed as a personal gift and the employees with this ability are considered key personnel and a talent which must be compensated and promoted with special care.

4) System Consulting Knowledge (SCK)

Logical and Analytical abilities, which in a "Certain Combination", can allow the development of the "Frame Software" of the required system. This type of knowledge represents a high degree of 'Problem Solving' ability using classic mathematic and logical tools as well as 'Heuristic Algorithms' which are essential in present R&D environment in almost all the disciplines.

5) Theoretical Multidisciplinary Knowledge (TMK)

The extension of TDOK to a considerable set of disciplines requires professionals with outstanding formal education, significant 'Self Study Ability' and a well established "High Speed Thinking Mechanism". These kind of employees are easily detected, but *no one* really knows (even the person involved), the ***secret*** behind this enormous knowledge ability.

6) Practical Multidisciplinary Knowledge (PMK)

The portion of TMK which is based ***only*** on *Empirical Experience*. This type of knowledge is developed through a continuous interaction between employees from different disciplines which participate in a given project. The employees with the best communication skills contribute considerably to team's performance and to the development of mutual PMK.

3.4.2 EXTRA DISCIPLINARY KNOWLEDGE

7) Problem Definition Ability (PDA)

Problem Definition Process is considered a ***crucial issue*** in an R&D environment. This activity **cannot** be conducted using "Structural Design Frameworks" and is actually based on the level of understanding of the ultimate goal, by the "key people" in the 'R&D Project' environment. Hence, the ability to "Translate" the ultimate goal to the adequate 'R&D Problem' is considered crucial in every project and has a tremendous influence on firm's success.

8) Problem Solving Ability (PSA)

Assuming the PDA was done properly, PSA actually "Translates" the PDA results into a specific set of "Assignments" which can now be defined using a variety of R&D techniques and procedures. It should be noted that **automatic design tools** can be used in a relative ***small portion*** of the PSA process – thus the "Human Knowledge" remains the main factor.

9) Self Learning Ability (SLA)

SLA is in my opinion, the most challenging issue in the context of Knowledge Oriented Performance – The human brain managed to "hide" the answer regarding the **origin** of this remarkable ability and basically we can only refer to it as a "Natural Gift" which is intensified by ***accumulative*** experience. Self learning ability can be evaluated indirectly using continuous focused observations on performance.

10) Knowledge Implementation Skills (KIS)

Knowledge in its "Passive State" has a ***very low*** meaningful influence on the surrounding environment. The key issue is the (Human) ability to implement the knowledge in the context of a new, meaningful creation (!). In terms of Company's business management, the 'New Product' is one of the main results of knowledge Implementation, namely the KIS of its employees (!!!).

11) Knowledge Oriented Communication Skills (KOCS)

KOCS represents one of the main "Vectors" of knowledge oriented ***interaction***. As a matter of fact, if a professional **does not** have KOCS at least at the basic level, he has no future in the R&D multidisciplinary environment. KOCS can be viewed as a subfield of "Human Oriented Interaction" ***built on*** a considerable amount of Knowledge (Formal and Informal) – regarding this wonderful process, it should be perfectly clear: Computers are "Out" !!!

12) Skills of Knowledge Evaluation from Raw Data (SKERD)

SKERD is probably one of the greatest challenges of the modern era – the ability to ***extract*** knowledge out of Information (Raw Data)!!! In the context of this article only a basic observation will be made: SKERD ***at present***, is a capability of Humans only – the known attempts to extract-transform information to knowledge using "Machines" (Computer-Based Algorithms), **failed** !

13) Analytic Ability (AA)

Models regarding AA, refer to this wonderful skill from numerous perspectives which are beyond the context of this article. However, employees' AA evaluation is a very important factor in the context of organization competiveness.

AA should be viewed from the "Logical-Associative Oriented" perspective, and can be used **explicitly** regarding the importance of 'Human Capital' in the "Main Business Strategy" context.

14) Creativity (C)

Creativity definition, even at the lowest level, is a huge challenge and perhaps a "Mission Impossible" task. However, the temptation to explore this ***unbelievable*** human skill is so strong, that it is trivial to understand the reality of the extraordinary large research activity concerning 'Human Creativity'. In the context of the EKEM model, creativity will be a meaningful factor. One important statement will be made: If 'Creativity' can be thought, than the implication of *improving performance* is straightforward and might lead to very interesting and practical results (!).

15) Imagination (I)

Dealing with the notion of **Imagination** can be a very frustrating experience – actually from the "Mathematics Perspective" it seems that ***nothing*** can be explored in this era!? This strong statement is based on a basic empirical fact: We ***cannot*** view Imagination directly! We can ***only*** observe its byproducts which in fact, in any given case, a great deal of "Results" can be obtained (**!**). On the other hand, everybody uses imagination continuously as a "Natural Habit" in endless possible circumstances. Having the previous arguments in mind, one thing is "Crystal Clear": It is a **must** to explore Imagination, it is essential to make any possible effort to **understand** what it ***really*** is **!!!**

In the context of the EKEM, imagination will be introduced very strongly as the "Wild Card" regarding Knowledge Oriented Performance (KOP) in general and "Talent Detection" in particular.

3.5 DATA ANALYSIS

The interviews conducted during the qualitative MCSR provided an overwhelming amount of data. Following the majority of Scholars opinion, the data was codified in a systematic way in order to gain a manageable structured "Data Base". A code can be defined as follows: ***A symbol applied to a group of words to classify or categorize them***. The actual data codification was carried out according to the following guidelines (Strauss, in Robson 1999):

a. Try to discover ***genuine categories*** and give them a name.
b. Relate these categories as specifically and variably as possible to the context in which they occur (e.g. relate the categories to the context of the questions in the interviews).
c. Relate categories to each other – construct sub-categories where appropriate.
d. The codification must be done ***only*** on specific data obtained during the empirical research.
e. Develop ***core categories*** and relate them to all categories and sub-categories (e.g. EDK criteria in the KOT taxonomy).
f. Discard totally or largely unrelated categories (i.e. - reducing the "Noise" in the data).

Coding in the context of the empirical research, took in consideration the implication of multiple case studies. The objective is to achieve an acceptable degree of standardization which makes cross-case comparisons a relatively straightforward task. The most obvious tactic is to construct a matrix which includes categorized data from all the cases. In practice the ***Meta-matrix ordered by cases*** was chosen. This type of matrix is described as follows (Miles & Huberman, in Robson 1999):
A matrix which includes coded data of explicit categories across all the case studies (Number of occurrences for each category). Meta-matrices are useful for generalization and pattern detection of qualitative data, within the data analysis process.

It should be noted that the actual (MR) codification of the raw data obtained during the interviews, took into account the following sources: **1.**Research Questions; **2.**KOT criteria; **3.**Variables related to the logical core of each question (i.e. questions Q1-Q10); **4.**Typical variables detected during data collection or first-stage analysis.

3.5.1 EXTERNAL VALIDATION

External Validation is defined as the domain to which the findings of the study can be generalized – in simple terms, External Validation is the ***degree*** to which findings can be generalized from the specific sample in the study (single case study) to some target populations (e.g. R&D employees in HT companies). Some scholars argue that External Validation or generalization, are justified only in

quantitative research where statistical generalization is straightforward. Following this argument the term 'Transferability' is introduced for qualitative research. In this context it is the responsibility of the person carrying out the research, to provide the "Data Base" to make transferability feasible to other settings (Kennedy; Lincoln & Guba, in Robson 1999).

3.5.1.1 Meta-analysis

Meta-analysis is a method of combining findings across research studies that has become increasingly popular in the social sciences (Hedges & Olkin ; Hunter et al. , in Jensen & Rodgers 2001). For many organization' oriented topics, only a meta-analysis that includes case studies can provide a solution to the ***knowledge-cumulation*** problem. Thus, the continued use of case study methodologies is essential for knowledge to advance especially MCSR. The basic idea is to analyze case studies' data ***cumulatively*** and still maintain the richness of detailed data. It is suggested that the results of each case should be synthesized as part of the whole network of research which will result with a defined set of study evidence (Jensen & Rodgers 2001).

The meta-analysis process is based on the research questions and is tested in the MR across organizational entities. In addition the implementation of Meta-matrices is considered a useful tool for demonstrating generalizability.

3.5.1.2 Empirical Research Considerations

In the context of the MR, the empirical research is expected to demonstrate transferability using a form of 'Analytical Generalization' based on the following arguments:

1. Interviews' structure was maintained for all the case studies.
2. The differences between the companies (refer to Section 3.2) enhance the logical chain for generalization when similar or identical results are obtained.
3. Meta-analysis is applicable in the empirical research.

3.5.2 INTERNAL VALIDATION

Internal Validation is defined as the extent to which a study establishes that a ***factor*** or variable has actually ***caused*** the ***effect*** that was found. Some scholars argue that Internal Validation is justified only in quantitative research – it is suggested to use the terminology of 'Credibility' which reflects the situation where the subject of enquiry is accurately identified and described (Lincoln & Guba, in Robson 1999). In this context multiple case studies are considered a good method for proving internal validation especially in international businesses (Pauwels & Matthyssens 2004).

In the context of the empirical research the Triangulation strategy was chosen. Triangulation is viewed as an indispensable tool for "real word" enquiry (Robson 1999). Triangulation was implemented during data collection assuming the same structure of inquiry (the actual interviews) on one hand and the differences between the companies on the other hand. From the logical perspective, the following arguments should be considered:

1. If two different cases give the same results than by definition they cross-validate each other.
2. Considering the structure of the interviews a 'synchronic primary data source triangulation' is achieved (Pauwels & Matthyssens 2004). Two measures should be noted: **1)** Interview's structure is similar for all cases (refer to Section 3.3); **2)** Different characteristics of the companies (refer to Section 3.2).
3. Cause-effect relationships will be analyzed by integration of answers to questions which resulted with overlapping results, within any given interview.

Chapter 4: ANALYZIND DATA and RESULT INTERPRETATIONS

4.1 GENERAL OPINION

1. **MEGR -** MEG problem recognition ➔ *MEG is recognized as a fundamental problem.*
2. **MEGP -** MEG effect on performance ➔ *Substantial effect on performance.*
3. **MEGK -** MEG effect on new knowledge generation ➔ *Negative effect.*
4. **MEGTF -** MEG affect on 'Technological Forecast Ability'➔ *Negative effect.*
5. **MEGMR -** MEG effect on Managers-Employees relationships ➔ *Severe negative effect !*
6. **MPSQ -** MEG effect on Product/System Quality ➔ *Negative effect.*
7. **MEGRP -** MEG effect on Recruitment Process ➔ *Impossible to evaluate !*

Note: CR – Cumulative Results – The sum of all occurrences in the given case studies.

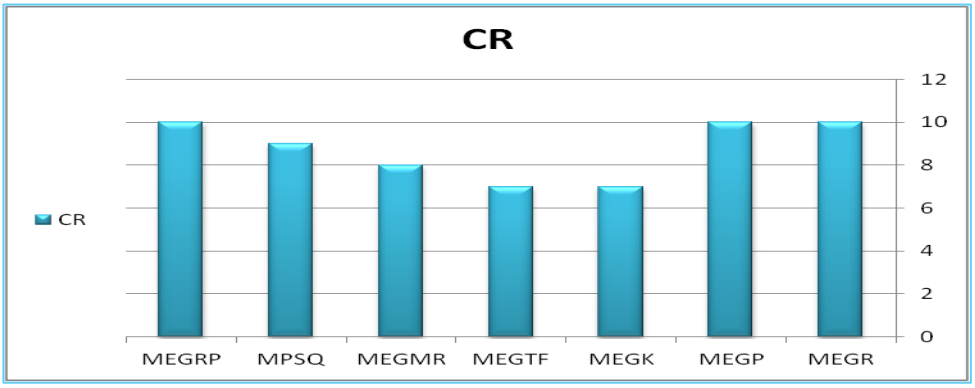

Figure 4.A - MEG problem characteristics

4.2 STANDARDIZED OPEN-ENDED INTERVIEW

4.2.1 Question-1 (Related directly to RQ2)

Q1: How you define the main performance constrains of the R&D Manager?

1. **S – Scheduling** ➔ *Precise Scheduling.*
2. **SS - System Specifications** ➔ *Optimal System Specification Demands.*
3. **KG1 - Knowledge Gaps[1]** ➔ *Strict Project Framework.*
4. **KG2 - Knowledge Gaps[2]** ➔ *More flexible assuming better innovation.*
5. **TC - Team Capability** ➔ *Team "On Target performance".*
6. **B1 - Budgeting[1]** ➔ *Strict Budget.*
7. **B2 - Budgeting[2]** ➔ *More flexible Budget (High-Risk R&D, "Cost Plus", etc.).*

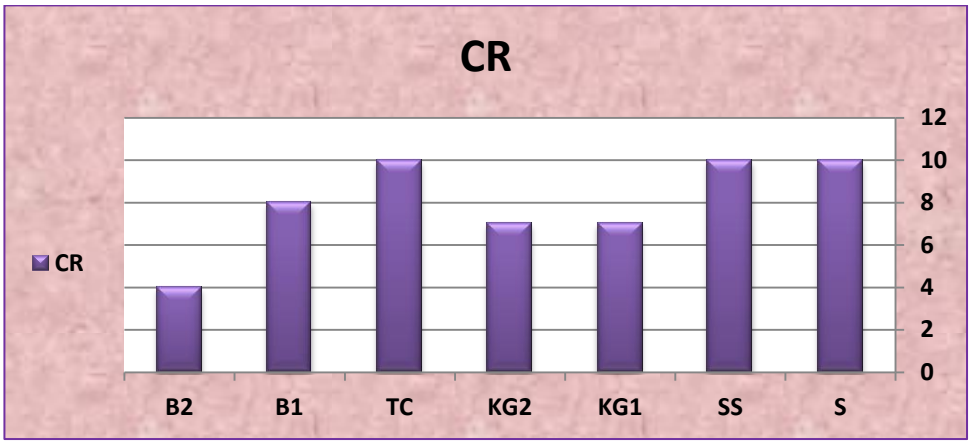

Figure 4.1 - R&D Managers' Performance Constrains [A1]

4.2.2 Question-2 (Related directly to RQ3)

Q1: How you define the general R&D Manager' Expectations from his Employees' performance?

1. **E - Engagement** ➔ *Employees engagement to mission.*
2. **F - Focus** ➔ *"On Target" requirements (Knowledge Gaps).*
3. **TCO - Team Collaboration** ➔ *Mutual collaboration requirement.*
4. **T - Testability** ➔ *Enable performance demonstration.*
5. **SAA - State of the Art Achievement** ➔ *significant progress in a world wide scale.*

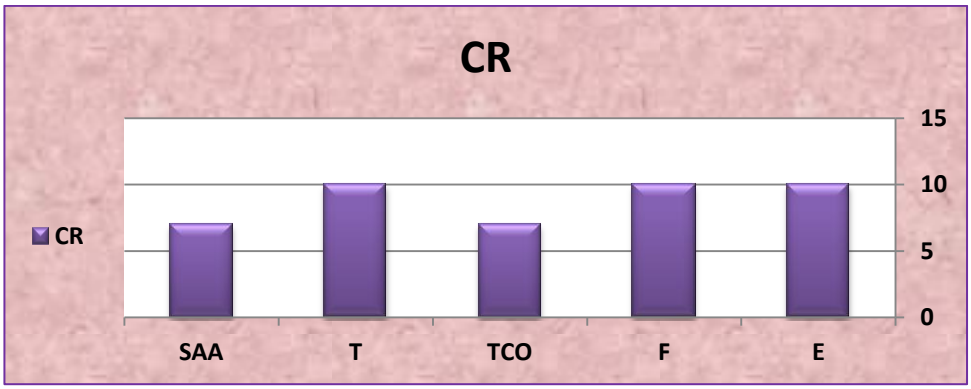

Figure 4.2 - General R&D Manager' Expectations [A2]

4.2.3 Question-3

Q3: How you define the main Knowledge Management (KM) Problems?

1. **S - Scheduling** ➔ *Strict R&D scheduling.*
2. **TK - Tacit Knowledge** ➔ Most of the knowledge resides in the people minds . . .
3. **SRKG - System Related Knowledge Gaps** ➔ relevant to R&D of large multidisciplinary systems.
4. **KE - Key Employees** ➔ *Key employees compensations.*
5. **KMS[1] - Knowledge Management Systems[1]** ➔ *KMS are used with restrictions to formal documentation.*
6. **KMS[2] - Knowledge Management Systems[2]** ➔ *KMS are not used at all.*
7. ***KM - Knowledge Marketing*** ➔ *Marketing contract includes* comprehensive documentation.
8. **T1 – Training[1]** ➔ *Systems Oriented Training (Knowledge Dissemination!).*
9. **T2 – Training[2]** ➔ *General courses related to new technologies, Software tools etc.*

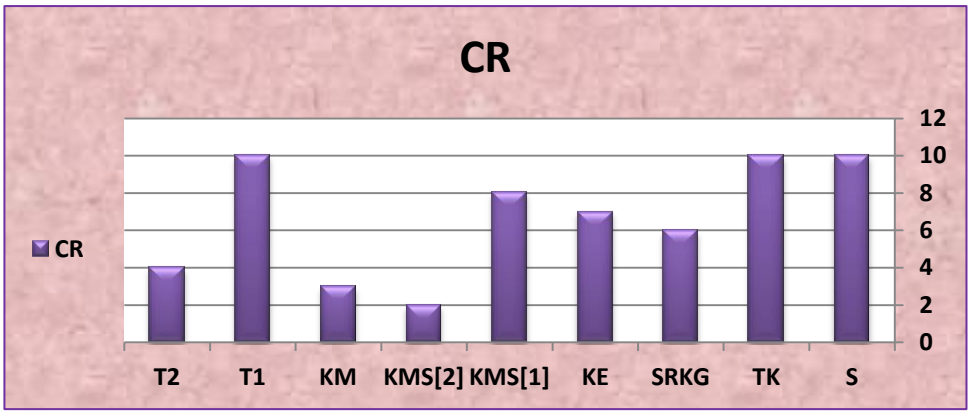

Figure 4.3 - Knowledge Management Problems [A3]

4.2.4 Question-4 (Related directly to RQ3)

Q4: How you define the main Knowledge Management principles and Strategy?

1. **KR – Key Resource** ➔ *Knowledge is considered a 'Key Resource' of the business.*
2. **CF – Competitive Force** ➔ *Knowledge is considered a 'Competitive Force'.*
3. **MKD – Managing the Knowledge Directly** ➔ *relevant to R&D of large multidisciplinary systems.*
4. **MKE – Managing the Knowledge through Employees** ➔ ***focus*** *on the key employees rather than supporting the knowledge generation process.*
5. **DIKM – Combination of "Direct Knowledge Management" and "Indirect Knowledge Management" through the employees.**
6. **KP – Knowledge Purchase** ➔ *strategy of buying other companies with the required new knowledge.*
7. **KCR – Key Candidates Recruitment** ➔ *Spotting key employees in other companies.*

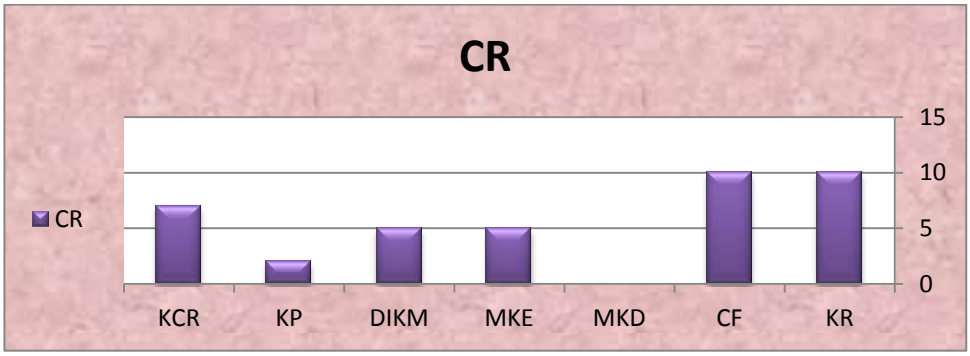

Figure 4.4 - Knowledge Management Principles and Strategy [A4]

4.2.5 Question-5 (Related directly to RQ3)

Q5: How you define the main Employee's Knowledge & Skills expectations of the R&D Manager?

1. **DOK – Discipline Oriented Knowledge** ➔ *A high level of DOK is expected.*
2. **PDA – Problem Definition Ability** ➔ *PD is considered a critical phase of R&D.*
3. **MDK – Multi Disciplinary Knowledge** ➔ *Theoretical and practical MDK is considered a must.*
4. **AA – Analytic Ability** ➔ *A vital "Natural Skill".*
5. **C – Creativity** ➔ *A 'Natural Driving Force' for genuine outstanding solutions.*
6. **OT - Original Thinking** ➔ *Cognitive skills based on imagination.*
7. **CS – Communication Skills** ➔ *efficient professional communication skills.*

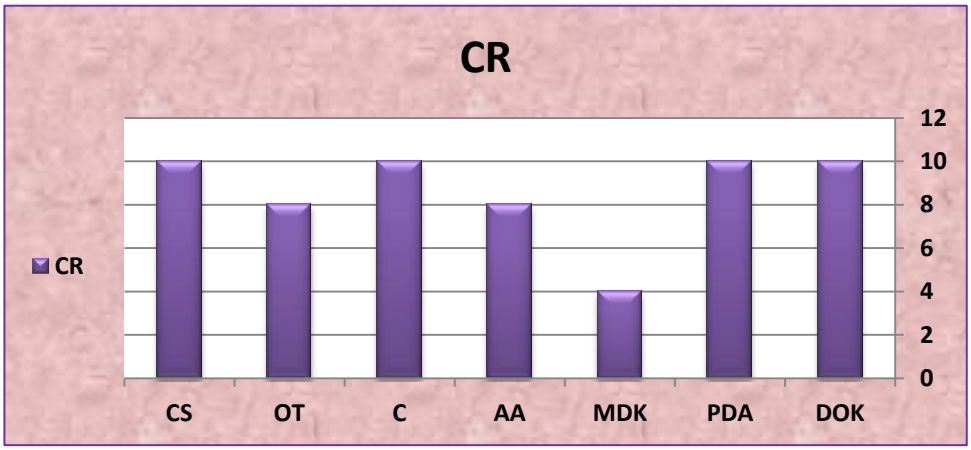

Figure 4.5 - Expectations of Employee's Knowledge & Skills [A5]

4.2.6 Question-6 (Related directly to RQ5)

Q6: How employees are evaluated by R&D managers?

1. **OJO – On the Job Observations** ➔ *observation through day by day interaction with the employees.*
2. **DRM – Design Review Meetings** ➔ *R&D forums for development status.*
3. **DRD – Design Review Documentation** ➔ *Review for performance evaluation.*
4. **PI – Personal Interviews** ➔ *A combination of professional and personal Interviews.*
5. **ER [1]– Evaluation Reports[1]** ➔ *Employee evaluation reports once per year.*
6. **ER [2]– Evaluation Reports[2]** ➔ *Employee evaluation reports several times per year.*

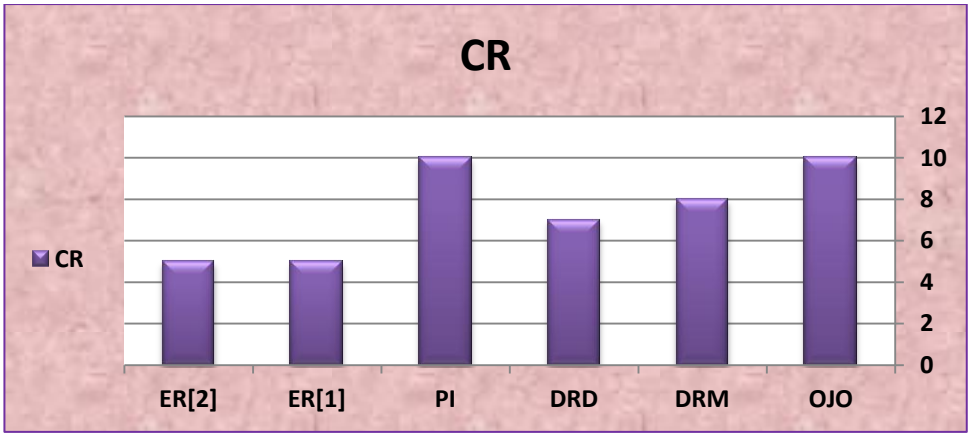

Figure 4.6 - Employee's Evaluation Methods and Tools [A6]

4.2.7 Question-7

Q7: How you define the Appraisal Strategy in your firm?

1. **EQC – Employees Quality Criteria** ➔ *PAS refers to employees' qualities (traits).*
2. **EBC – Employees Behavior Criteria** ➔ *PAS refers to employees' behavior.*
3. **ETOC – Employees Task Outcomes Criteria** ➔ *PAS refers to the actual outcomes in a given project which can be directly related to performance.*
4. **PE – Peers Evaluation** ➔ *open peers evaluations in addition to managers' employees' evaluation.*
5. **AR - Appraisal Reports** ➔ *Evaluation Reports which are presented to the employee.*
6. **NJA[1] - New Job Assignment[1]** ➔ *PAS results are used for advancing qualified employees to higher level jobs.*
7. **NJA[2] - New Job Assignment[2]** ➔ *PAS results are used for assigning under qualified employees to lower level jobs or fired in the worst case.*
8. **SI – Salary Increase** ➔ *PAS results are used for salary increase decisions.*
9. **CSR - Company Shares Reward** ➔ *PAS results are used for company shares rewards decisions.*
10. **TPR – Training Programs Reward** ➔ *PAS results are used for granting employees special programs of training and even formal academic studies.*

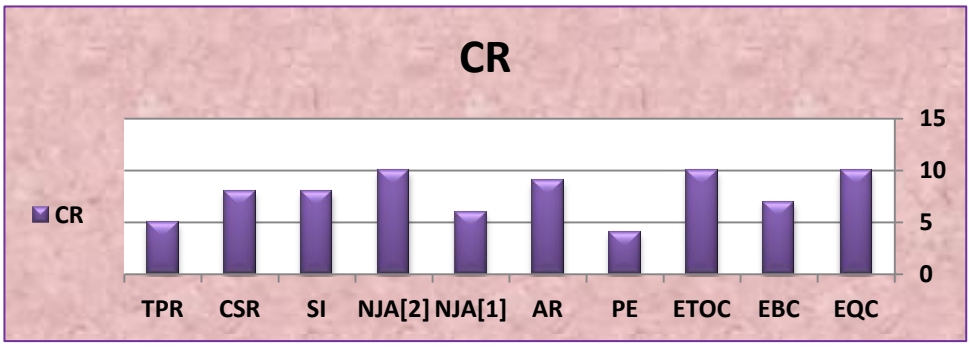

Figure 4.7 - Appraisal Strategy Elements [A7]

4.2.8 Question-8

Q8: How HRM functions are implemented in your company?

1. **S – Stuffing** ➔ **A very comprehensive process:** *CV, Written Professional /Psychological Tests, Oral Tests and Personal Interviews.*
2. **PA – Performance Appraisal** ➔ *1 to 4 times a year based on firm's revenue.*
3. **CB – Compensation & Benefits** ➔ *1 to 4 times a year based on employee's evaluation with considerable freedom to compensate outstanding employees.*
4. **TD[1] – Training & Development** ➔ *TD is implemented with emphasis on outstanding employees.*
5. **TD[2] – Training & Development** ➔ *TD programs are very restricted by definition.*
6. **ELR – Employee and Labor Relations** ➔ *Not relevant – No Employees' Unions.*
7. **SH – Safety & Health** ➔ *Regulated according to state laws.*
8. **HRR – Human Resource Research** ➔ *HRR aims to maintain an up to date status regarding all the HRM functions in general and within the organization.*

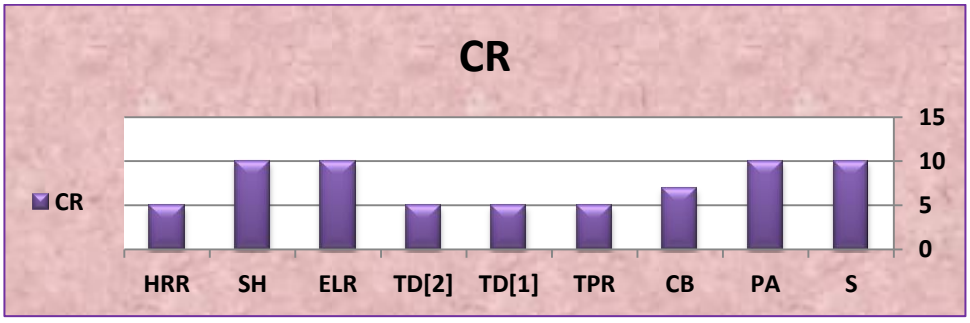

Figure 4.8 - HRM Functions Implementations [A8]

4.2.9 Question-9

Q9: How you define the Comprehensive Strategy?

1. **LPGM – Leading Position in the Global Markets** ➔ *The main objective of the firm which is strongly related to an efficient and successful R&D process.*
2. **CPGM – Competitive Position in the Global Markets** ➔ *The main objective of the firm which is strongly related to an efficient and successful R&D process.*
3. **CSC – Company Subsidiary Coordination** ➔ *Relevant to MNC Companies.*
4. **LTI – Long Term Innovation** ➔ *Considered the "Growth Engine" of the company.*
5. **LET[1] – Leading Edge Technologies[1]** ➔ *LET are obtained through "In House" General Technology-Scientific research.*
6. **LET[2] – Leading Edge Technologies[2]** ➔ *LET are obtained through partnerships and investments in adequate companies.*
7. **HC[1] – Human Capital[1]** ➔ *HC is considered an important factor but not a crucial one !?*
8. **HC[2] – Human Capital[2]** ➔ *HC is considered a crucial factor.*

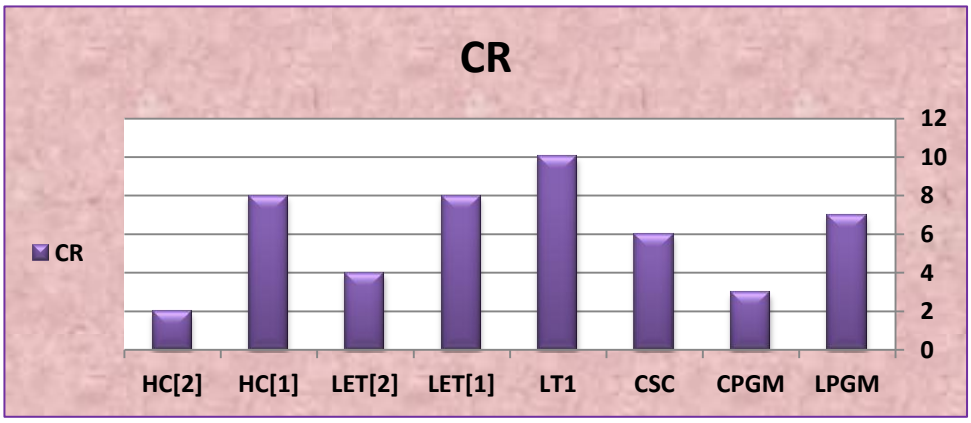

Figure 4.9 - Comprehensive Strategy Perspective [A9]

4.2.10 Question-10 (Related indirectly to RQ5)

Q10: How you define the main "On Target" performance expectations of the R&D Manager?

1. **E - Engagement** ➔ *Employees engagement to mission.*
2. **FCR– Focus on Customer Requirements.**
3. **FMF– Focus on Markets Forecasts and customers feedback.**
4. **FWD – Focus on What should be Done** ➔ *considering customer requirements as a must, there should be a focus on what should be done, and not what can be done which requires more resources.*
5. **CSPM – Consider Seriously the Project Milestones** ➔ *'Timing' is a crucial parameter in the HT markets . . .*

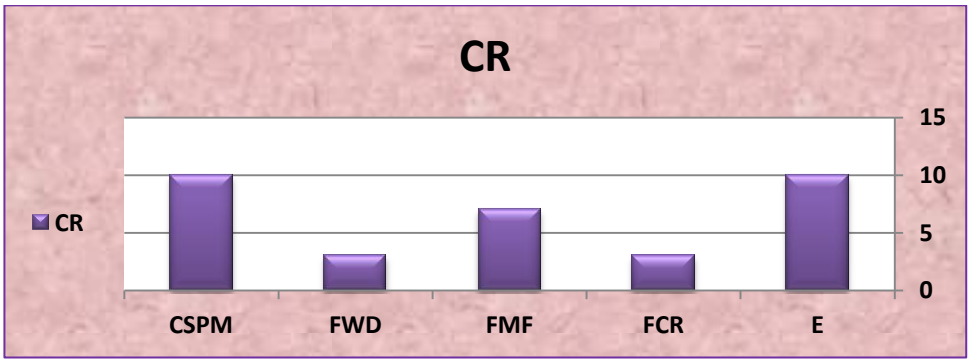

Figure 4.10 - "On Target" Performance Expectations [A10]

4.3 GUIDED INTERVIEW

In the context of the 'Guided Interview' I implemented a Taxonomy Based MEG exploration. The genuine Knowledge Oriented Taxonomy was used (Refer to Section 3.4). All the interviewees showed great interest in the taxonomy and the majority opinion was that this taxonomy captures all the 'Extra Disciplinary Knowledge' parameters and can be practically used to define the MEG problem. The following guided interview was used to capture the interview observations regarding five MEG oriented issues:

1. EDK criteria relevance to R&D.
2. EDK criteria relevance to MEG description.
3. Profile of the "Ideal Employee".
4. Profile of the "Ideal System Engineer".
5. Profile of the estimated "Gap Profile"

4.3.1 EDK criteria relevance to R&D

The KOT's EDK criteria relevance for the R&D environment. Each criterion is quantified on a scale of 1 to 5. In this case, 1 represents Least relevance up to 5 which represents Most relevance to the R&D environment.

Note: A&R – Average & Rounding – The average and rounding of the cumulative results.

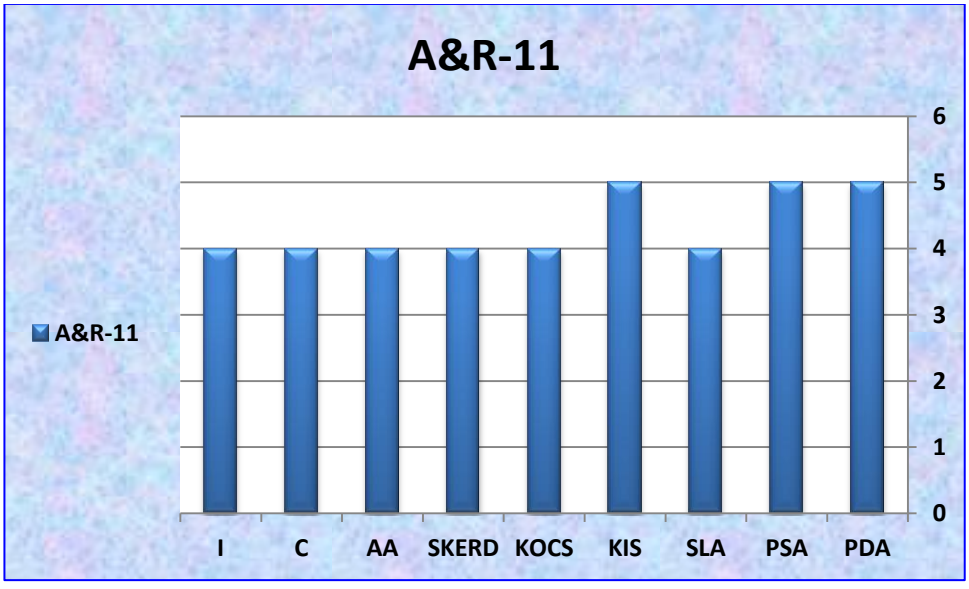

Figure 4.11 – EDK criteria relevance to R&D

4.3.2 EDK criteria relevance to MEG description

The relevance of KOT's criteria for MEG description – the objective is to define for each criterion the feasibility for the purpose of evaluating employees. Each criterion is quantified on a scale of 1 to 5. In this case, 1 represents the ***lowest feasibility*** up to 5 which represents the ***highest feasibility***. Figure 4.12 reflects **high correlation** between EDK relevance to R&D (A&R11) and the relevance to MEG description (A&R12):

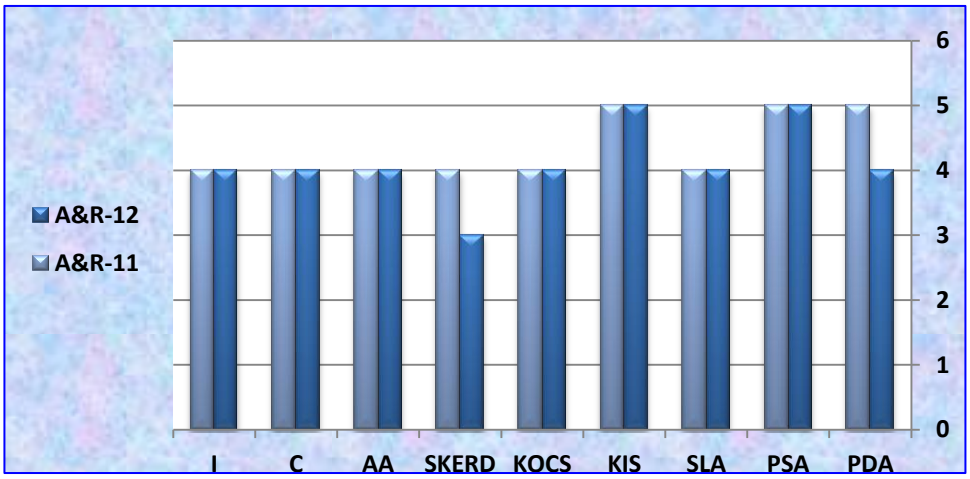

Figure 4.12 – EDK criteria relevance to MEG description

4.3.3 Profile of the "Ideal Employee"

The profile of the "Ideal Employee" assuming a R&D professional with no management position. Each criterion is quantified on a scale of 1 to 10. In this case, 1 represents the lowest qualification up to 10 which represents the highest qualification. Figure 4.13 describes the ***threshold requirements*** for the "Ideal Profile".

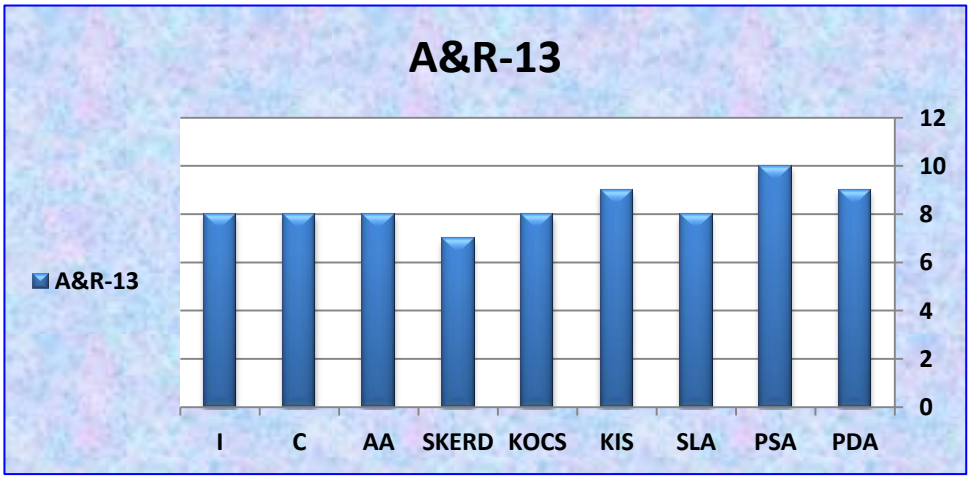

Figure 4.13 – Profile of the "Ideal Employee"

4.3.4 Profile of the "Ideal System Engineer"

The profile of the "Ideal System Engineer" with the responsibility of functional specifications definitions of the required system in development. Figure 4.14 describes the ***threshold requirements*** for the "Ideal Profile".

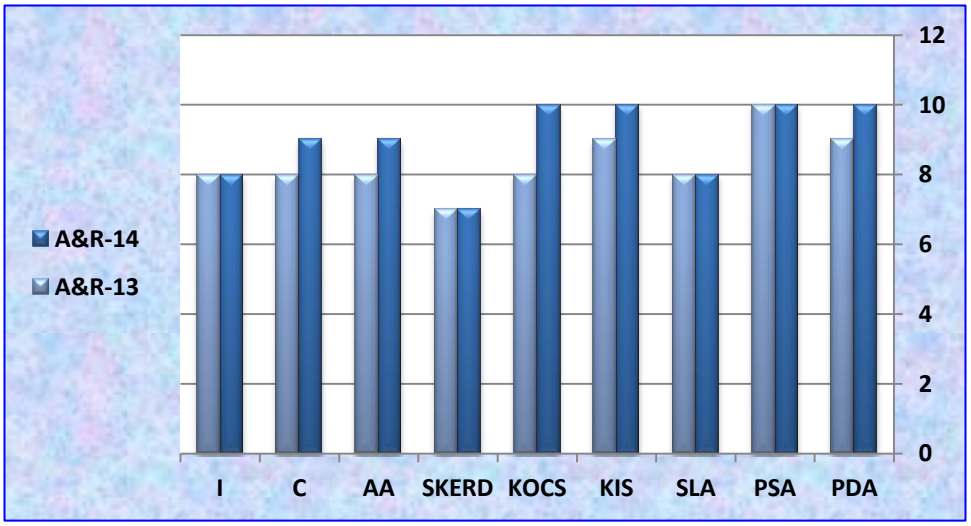

Figure 4.14 – Profile of the "Ideal System Engineer"

4.3.5 MEG gravity estimated Profile

The estimate of the gravity of the MEG problem from a general perspective which actually defines the 'Gap General Profile'. Figure 4.15 displays the "Spectrum" of the gap based on interviewees experience of evaluating employees. The objective is to define for each criterion the intensity of the gap - Each criterion is quantified on a scale of 1 to 10. In this case, 1 represents the ***lowest gap*** up to 10 which represents the ***highest gap***.

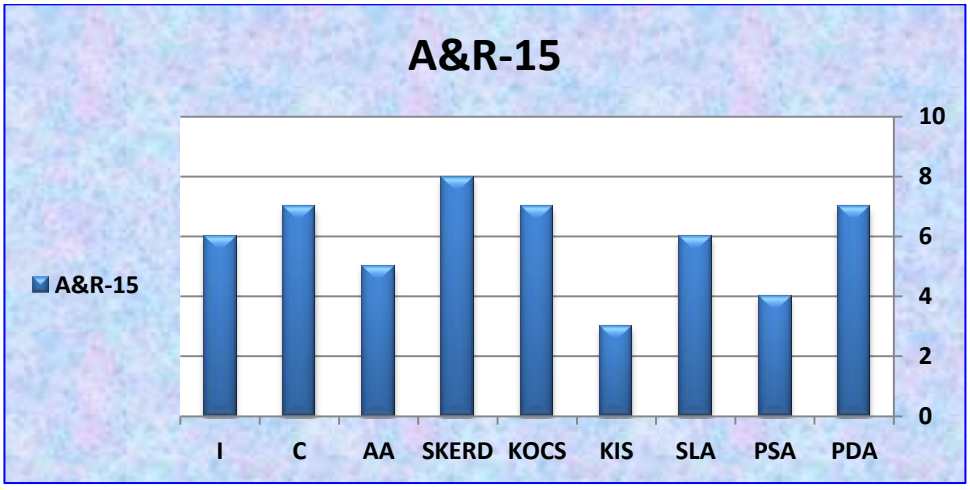

Figure 4.15 – MEG gravity estimated Profile

4.3.6 DOK parameters relevance to the MEG problem

All the interviewees stated that DOK parameters are less relevant for employees' evaluation since these are trivial requirements which are tested during the recruiting process. This approach corresponds to these Multiple Case Studies assumptions as well as the MR. Therefore it is assumed that the hired candidates have the adequate DOK based on formal education and previous implementation experience.

4.4 INTERNAL VALIDATION

The 'Empirical Research' revealed 'Internal Validation' (Credibility) at the core of the study. Considering the actual structure of the Interviews and adopting the Triangulation strategy, resulted with two types of results:

1. **Internal Validation at the macro level** – The interviews detected the actual cause-effect relationships between the questions during the 'Standardized open-ended interview' and in fact acknowledged the intended design of the questions.
2. **Internal Validation at the micro level** – The analysis of the answers revealed some interesting cause-effect relationships between the parameters of the "Cause Answer" and specific parameters of the "Effect Answer/s". Since the interviews were not designed to reveal such detailed relationships, these results are challenging with a potential of deeper understanding of the complicated nature of the MEG problem.

4.4.1 INTERNAL VALIDATION AT THE MACRO LEVEL

Four 'Cause-Effect' (C-E) relationships were detected. As stated before, these results were expected and correspond to the premise of the research.

1. **C-E Relationship 1:**

Cause – Answer3

Parameters	S	TK	SRKG	KE	KMS[1]	KMS[2]	KM	T1	T2
CR-A3	10	10	6	7	8	2	3	10	4

KM Problems

Effect – Answer4

Parameters	KR	CF	MKD	MKE	CMDE	KP	KCR
CR-A4	10	10	0	5	5	2	7

KM Principles and Strategy

2. C-E Relationship 2:

Cause – ***Answer1***

Parameters	S	SS	KG1	KG2	TC	B1	B2
CR-A1	10	6	7	7	10	8	4

Managers' Constrains

Effects

Answer2

Parameters	E	F	TCO	T	SAA
CR-A2	10	10	7	10	7

Performance Expectations

Answer5

Parameters	DOK	PDA	MDK	AA	C	OT	CS
CR-A5	10	10	4	8	10	8	10

Knowledge and Skills Expectations

Answer10

Parameters	E	FCR	FMF	FWD	CSPM
CR-A10	10	3	7	3	10

"On Target" Performance Expectations

3. C-E Relationship 3:

Cause – ***Answer3***

Parameters	S	TK	SRKG	KE	KMS[1]	KMS[2]	KM	T1	T2
CR-A3	10	10	6	7	8	2	3	10	4

KM Problems

Effect – ***Answer4***

Parameters	KR	CF	MKD	MKE	CMDE	KP	KCR
CR-A4	10	10	0	5	5	2	7

KM Principles and Strategy

4. C-E Relationship 4:

Cause – ***Answer6***

Parameters	OJO	DRM	DRD	PI	ER[1]	ER[2]
CR-A6	10	8	7	10	5	5

Employee Evaluation Parameters

Effects

Answer7

Parameters	EQC	EBC	ETOC	PE	AR	NJA[1]		NJA[2]	SI	CSR	TPR
CR-A7	10	7	10	4	9	6		10	8	8	5

Employees Appraisal Strategy

Answer8

Parameters	S	PA	CB	TPR	TD[1]	TD[2]	ELR	SH	HRR
CR-A8	10	10	7	5	5	5	10	10	5

HRM's Functions Implementation

5. C-E Relationship 5:

Cause – ***Answer9***

Parameters	LPGM	CPGM	CSC	LTI	LET[1]	LET[2]	HC[1]	HC[2]
CR-A9	7	3	6	10	8	4	8	2

Companies' Comprehensive Strategy

Effect – ***Answer1***

Parameters	S	SS	KG1	KG2	TC	B1	B2
CR-A1	10	6	7	7	10	8	4

R&D Managers' Constrains

4.4.2 INTERNAL VALIDATION AT THE MICRO LEVEL

In this context some interesting and valuable C-S relationships are introduced. This information was offered freely by the interviewees and should be considered very seriously. In fact further empirical study in the future looks promising.

Note: The cause-effect relationships are introduced in the following formulation:

[Cause Parameters] ➔ [Effect parameters]

1. **Performance Constrains C-E Relationships:**

   - **A1[SS] ➔ A2[F;TCO]** – System Specifications ➔ Focus & Team Collaboration Expectations.
   - **A1[KG1;KG2] ➔ A2[SAA] ; A5[OT]** – Closing Knowledge Gaps ➔ State of the Art Achievements & Original Thinking skills, expectations.
   - **A1[B1;B2] ➔ A10[FWD;CSPM]** – Budgeting Constrains ➔ Focus on What should be Done & Considering Seriously the Project Milestones.
   - **A1[S;SS] ➔ A10[CSPM]** – Scheduling & System Specifications ➔ Considering Seriously the Project Milestones.
   - **A1[TC] ➔ A5[CS] ; A10[E]** – Team Capability ➔ Communication Skills & Engagement requirements.

2. **KM Problems C-E Relationships:**

   - **A3[TK] ➔ A4[KR;CF;MKE] –** Tacit Knowledge ➔ Strategy which considers Knowledge as a Key Resource and a Competitive Force & Managing Knowledge through Employees.
   - **A3[KMS[2]] ➔ A4[MKE] –** KMS Systems are not used at all ➔ Strategy of Managing Knowledge through Employees.

3. **.Employees Evaluation C-E Relationship:**

A6[ER[1];ER[2]] ➔ A7[NJA[1];SI;CSR;TPR] ; A8[TD[1];PA;CB] – Evaluation Reports ➔ Appraisal Strategy (New Job Assignments, Salary Increase, Company Shares Reward and Training Rewards) & HRM (Training & Development for outstanding employees, Performance Appraisal and Compensations and Benefits).

4. **Comprehensive Strategy C-E Relationship:**

A9[LTI;LET[1];HC[2]] ➔ A1[KG2] – Long Term Innovation & "In House" Scientific Research & Considering the 'Human Capital' a crucial factor ➔ The Time Constrains are more flexible and employees are encouraged to pursue R&D activities which are not necessarily focused on the project at hand (!).

Chapter 5: EKEM MODEL

Introduction

This chapter will introduce a *genuine 'Employee Knowledge Evaluation Model'* (EKEM) with strong relationships to the knowledge-intensive R&D activity conducted mainly in the HT industry. This model is supported by the KOT Taxonomy which was introduced earlier (Section 3.4). This model assumes by definition that the explicit knowledge criteria can be identified and evaluated in most cases through performance.

The EKEM model should be viewed as an important result of the MR since it is based on the well justified representation of the MEG problem.

5.1 METHODOLOGY

Methodology by definition represents a philosophical approach – this reference point, leads to a very complicated and disputed mechanism of 'Methods' and 'Principles' regarding the research of a particular subject. A deeper study into the actual meaning of **Ontology** on one hand and **Epistemology** on the other hand, arises some fundamental questions which may lead to the development of a "**more tangible"** set of tools. As an example, present research refers to "Business Semantics" instead of Ontology (Chisholm 2010).

In the context of this chapter, the conservative approach will be maintained. The methodology will be built carefully based on the philosophical requirements of Ontology and Epistemology. In the attempt to establish the desired methodology, a clear list of requirements must be defined – these requirements will be the set of parameters which will be attached to a certain Job or Employee in the evaluation process. The **Knowledge Oriented Taxonomy** introduced in Section 3.4 is considered the "Core" of the methodology, which focus on 'Knowledge Oriented Skills' required mostly in the R&D environment.

The suggested Employee (Candidate) Knowledge Evaluation is conducted in the following **Stages**:

1. **Requirements Definition** - Definition of the **set** of knowledge skills requirements from an employee at a given position. In the case of recruitment of candidates the requirements correspond to the actual Job opening. In practical terms, an adequate set of parameters are chosen from the given taxonomy (Section 3.4).

2. **Employee'/Candidate' Profile Definition** - Each Parameter is quantified on a scale of 1 to 10. In this case, 1 represents the lowest qualification and 10 represent the highest qualification. The set of quantified parameters establish the threshold level (Quality) of the 'Required Employee Profile' (REP) in a given position or the *'Required Candidate Profile'* (RCP) for a certain job.

3. **Actual Evaluation Process** – In this stage each parameter is evaluated separately using one or more evaluation procedures. At the end of this stage the *'Actual Employee Profile'* (AEP) is established with quantifiable measures. Similarly the *'Actual Candidate Profile'* (ACP) can be obtained.

4. **Management decision making** – The decision process in our case cannot be performed automatically since the evaluation process involves numerous parameters which may result with *different* employee profiles which could be considered as satisfactory. Furthermore addressing a multivariable problem with complicated relation among variables requires an "Intelligent Process" which only a professional human can conduct. The 'Spider Chart' (ACCEL 2010) is recommended. Consider the example in **Figure 5.1**:

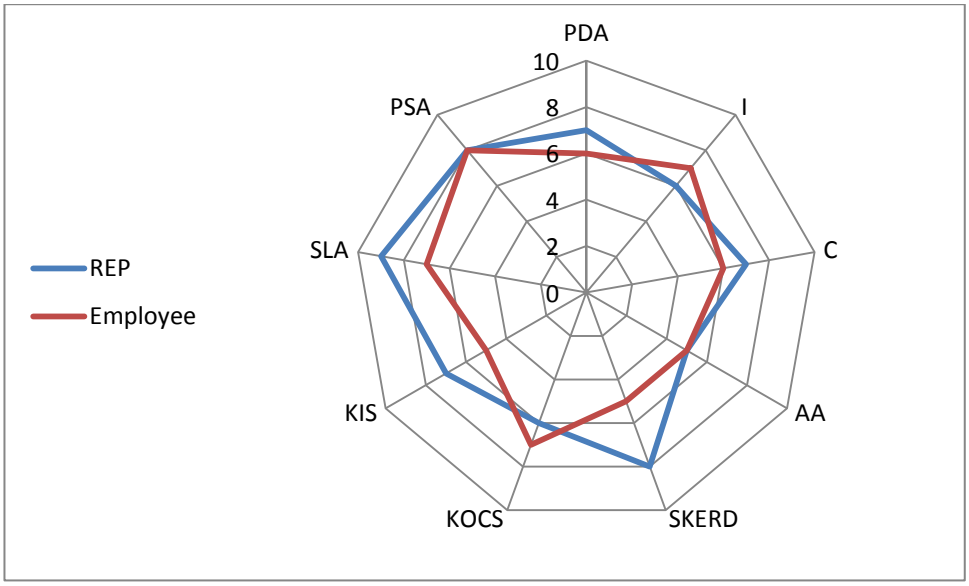

Figure 5.1 – Employee Evaluation Spider Diagram

Two main approaches can be used in the decision making process:

a. ***Relative Evaluation*** – in this case no RCP/REP is defined so that no "Reference Profile" is used. In this case the employees are ranked relatively to other and the best employees/candidates can be detected. This approach is feasible for cases where the

REP/RCP is difficult to define or for the purpose of *extracting* the REP/RCP which should be used in Stage2.

b. ***Absolute evaluation*** – In this case the REP/RCP is used as reference for ACP/AEP evaluation. During the evaluation process the manager may allow some *latitude* for each parameter of the REP/RCP – this approach may result with adequate employees with slightly different profiles.

5. **Management implications –** The selection process concluded in stage 4 may lead to managerial decision at two levels:
   a. ***Micro level*** – Candidates recruitment, Employee Appraisal, performance issues at employee or team levels, etc.
   b. ***Macro Level*** – Training needs, Performance issues at project level, marketing initiatives etc.

The actual Evaluation Processes introduced in **Stage3** is expected to gather a great amount of information. It is important to focus on procedures (sources) which match the knowledge/skill characteristics. The following sources can be used: **1.** Candidate job application; **2.** Resume (CV); **3.** Job Interview; **4.** Discussion with former employers; **5.** Psychological tests; **6.** Cognitive tests; **7.** Disciplinary Oriented Tests; **8.** Actual on the job observation – essential for employee evaluation; **9.** Design Reviews – Monthly Reviews, PDR, CDR; **10.** Professional Reports; **11.** Personal Interviews.

5.2 CONCLUSIONS

5.2.1 TAXONOMY ADVANTAGES

The Taxonomy introduced in Section 3.4, defines in most cases practical knowledge characteristics or skills which are vital for the R&D process. In fact most criteria were chosen based on the required performance through each stage of the R&D process which is considered common knowledge. Hence, most criteria can be evaluated based on the performance demonstrated by the employee. Implementing the evaluation model on this taxonomy has the advantage of giving reliable information not only for employee evaluation but also decision support results which will improve innovation toward firm's success.

5.2.2 CANDIDATES EVALUATION

Candidate Evaluation is a special case since on the job performance information is not available. In these cases the first seven sources of information mentioned in Section 5.1 may be used (please note the various taxonomy criteria which may be evaluated):

1. *Candidate job application* – PDOK, SEMK
2. *Resume (CV)* – PDOK, SEMK
3. *Job Interview* – PDOK, SEMK
4. *Discussion with former employers* – 2nd hand information with restricted details and reliability.
5. *Psychological tests* (beyond the context of this publication)
6. *Cognitive tests* – IQ tests or similar.
7. *Disciplinary Oriented Tests* – TDOK, SCK

Candidate evaluation in general is complex and inaccurate since the crucial job requirements cannot be evaluated especially the EDK criteria which are vital for recruitment of R&D professionals.

5.2.3 EMPLOYEES EVALUATION

Employee evaluation should be considered a major management task which should be practiced continuously by *in depth* observations – doing so, the precise information about performance can be obtained and easily related to the taxonomy criteria especially the EDK group. In this case the following resources should be used:

1. ***Disciplinary Oriented Tests*** – TDOK, SCK.
2. ***Actual on the job observation*** – informal interaction with employees on regular bases. This activity should be utilized extensively since it is critical for employee evaluation, especially of the EDK group.
3. ***Design Reviews*** – Monthly Reviews, PDR, CDR. These forums which focus on the actual R&D process are very useful in detecting the gifted employees in areas which correspond to most taxonomy's criteria.
4. ***Professional Reports*** – Frontal and written reports demonstrate the 'Project R&D Status' and reveal the "Key Employees" in distinguished areas which again correspond to most taxonomy's criteria.
5. ***Personal Interviews*** – Personal Interviews should be handled with care. By establishing the right "Atmosphere" a considerable amount of information can be obtained from the employee allowing a useful professional evaluation.

5.2.4 MODEL IMPLEMENTATION POSSIBILITIES

The model at hand (EKEM) was suited for the HT industry with strong ties to the R&D process. However considering the 'Product Life Cycle' (PLC) additional implementation possibilities can be considered. A short review of the PLC from the implementation perspective is as follows:

1. **R&D** – The main implementation of EKEM.

2. **Prototype transfer from R&D to Production** – This transfer includes a comprehensive knowledge transfer which is used for the 'Debugging Process' (Troubleshooting) at all levels (Component level, Unit Level and System level). The EKEM model can be used for evaluating the employees involved in the 'Debugging Process' – The required profiles will be lower compared to the R&D employees.

3. **Marketing and Sales** – Marketing and sales of HT products involves in depth consideration of the knowledge attached to the product which in most cases reflect some aspects of the state of the art in a particular market. Due to the strategy implications, the EKEM utilization will be addressed in Section 5.2.5.

4. **Field Operation** – this state refers to the maintenance activity performed at customer site during the actual Product/System utilization. Maintenance personnel need to have a comprehensive knowledge of the product and a high degree of Troubleshooting ability. The EKEM model applies with somewhat lower requirements compared to the R&D employees but higher than production employees.

5.2.5 FIRMS STRATEGY CONSIDERATIONS

Firms' Strategy approach was introduces throughout this study – in this section the strategy ingredients tied to the EKEM model are formulated as follows (please note that a *comprehensive* introduction of firms' strategy is beyond the context of this model):

1. **Recruitment** – Two main aspects should be considered:
   - Candidates' selection.
   - Jobs description based on detected knowledge gaps.

2. **Appraisal** – The following aspects should be considered:
   - Positive feedback at regular bases and adequate promotions.
   - Financial benefits.
   - Use "Talent Detection" for special promotions and benefits.

3. **Training** – Continuous training programs with the objective of 'Learning Organization'. Two main programs should be considered:
   - Project Oriented Training with the objective of knowledge dissemination in the organization.

- Discipline Oriented Training with the objective of updating the personnel with state of the art knowledge.

4. **Knowledge Management** – One of the most challenging tasks which is strongly related to employees' evaluation. In the context of this model the following objectives should be considered:
   - Spotting employees with Critical Explicit Knowledge.
   - Spotting employees with Critical Tacit Knowledge.
   - Deploying 'Knowledge Transfer' initiatives.
   - Detecting strategically knowledge gapes (Discipline Oriented, Project Oriented and Marketing Oriented).

5. **Marketing** – Marketing in HT industry is strongly connected to R&D and therefore the knowledge is considered a primary variable. In practice, marketing and R&D departments maintain "Symbiotic Relations". The following issues should be considered:
   - Detection of "Markets Status" in terms of competitive knowledge.
   - Define R&D challenges in terms of products with marketing success predictions.
   - Using the product oriented knowledge in the actual promotion initiatives.
   - Translate the marketing strategy in terms of R&D investments.

6. **Sales** – The tactical procedures of the actual sales to customers. The following issues should be considered:
   - Sales personnel must maintain an in depth knowledge of the product.
   - Sales personnel should be very attentive to customer feedback. In the context of knowledge this feedback may result with ideas for new products' development.

5.2.6 'EKEM' MODEL LIMITATIONS

The EKEM model is restricted to **practical/objective** qualities which are tied to performance. Following this perspective, the model **will not** address employees' requirements regarding personality or psychological attitude. As a matter of fact, this model assumes the ***most qualified employees*** from the psychological point of view. Hopefully this approach will prevent *ambiguity* during the actual evaluation and reduce to minimum the *deviations* in the "Raw Data" interpretation. However, the 'Psychological Profile' of employees must also be considered in order to obtain a comprehensive evaluation. It is therefore suggested to combine a psychological evaluation process with the EKEM model and utilize the comprehensive results in the actual decision making process.

Chapter 6: FINAL CONCLUSIONS and PERSONAL CONTRIBUTION

6.1 CONCLUSIONS

This thesis offered an in-depth analysis of the MEG problem in its "natural" settings. Therefore the conclusions of the MR at this point should be acknowledged and understood. In this section all the conclusion of the MR will be briefly introduced, to allow a comprehensive "Panoramic View".

The overall conclusions of the MR are expected to consider the strong ties of the MEG problem to the general perspective of innovation and KM in the HT industry. Therefore the conclusions will be presented in two groups:

- Group A – General Conclusions
- Group B – MR Specific Conclusions

Group A – General Conclusions

Conclusions based on the present MR which correspond to the scholars' opinion introduced in the worldwide literature. These conclusions can be viewed as valid in a broad context:

1. R&D is a fundamental ingredient for innovation toward technological leadership and long term firm's success.
2. The global nature of HT markets establishes a merciless competitive reality.
3. The constant efforts for "state of the art" solutions impose a serious consideration of the notion of knowledge in general and the objectives of KM in particular.

Group B – MR Specific Conclusions

The specific conclusions of the MR are naturally strongly connected to the research questions which were fully addressed during the empirical research. The conclusions are as follows:

1. The MEG problem is manifested **only by** the Extra Disciplinary Knowledge (EDK) gaps – The Disciplinary Oriented Knowledge (DOK) gaps are usually omitted because they are considered during the candidate' recruitment process.
2. The MEG problem has a significant impact on Innovation in general and R&D process' quality in particular.
3. MEG most problematic parameter is the luck of 'Knowledge Evaluation Skills' from 'Raw Data' (SKERD parameter in the MR Taxonomy).

4. Considering the critical importance of the R&D process, it is essential to evaluate R&D employees based on EDK criteria. In this context the EKEM model (Chapter 5) is recommended for implementation and further research.
5. The notion of the "Ideal Employee Profile" can be directly "translated" to the adequate HRM functions with emphasis on Training and Appraisal.
6. Unfortunately, the senior management in HT firms do not appreciate strongly the importance of the "Human Capital". This reality reflects a deep difference of opinion with most scholars in the academic world.

6.2 PERSONAL CONTRIBUTION

The actual research introduced in this Thesis, was chosen based on my experience in R&D managing positions in the HT industry. According to my experience, the R&D process plays a vital role in the Knowledge-intensive "HT Playground". Furthermore, the performance of the R&D teams must be considered vital in the context of the long term strategy for innovation.

6.2.1 LITERATURE REVIEW APPROACH

My approach to the literature review was to investigate the academic perspective of the majority of the scholars in two core issues:

1. The updated views regarding the main disciplines which are relevant in the above context. Considering the overwhelming amount of research the focus was on the most important business oriented disciplines: SHRM, KM in HT Industries, Employees Evaluation Methods, Marketing and Globalization.
2. A deep theoretical research in the context of Knowledge manipulation and Knowledge Management in the R&D environment.

Considering this theoretical research, the literature produces ample knowledge regarding 'Knowledge Management' and 'Performance Management'. However, within the ***context*** of the **gap** between 'Managers' Expectations' and 'Employees' Performance', **no knowledge** was found about performance related to knowledge (**!**). My personal contribution is addressing the gap problem using *in-depth distinctive knowledge ingredients* (The genuine Taxonomy) which are linked to employee performance. This approach resulted with a valid characterization (Mapping) of the MEG problem which hopefully establishes an original fundamental understanding of this problem.

In practical terms, this research offers explicit implementation in the context of employee evaluation and the required management tools which are directed to improve innovation in a comprehensive context.

6.2.2 HYPOTHESIS AND OBJECTIVES

The Hypothesis of this research emerged from my long and significant experience in the HT industry and is based on many encounters with colleges considering the crucial MEG problem. In fact this hypothesis opened a most important subject of interest in the Business Management discipline which can encourage research in HRM, KM and many others fields. Therefore the research questions which emerged from the hypothesis reflect the actual interpretation of the hypothesis.

6.2.3 APPLICATION OF RESEARCH INSTRUMENTS

My research introduced two main instruments which contributed to the "Logical Foundation" of the research:

1. A genuine knowledge oriented taxonomy – This taxonomy made the knowledge parameters accessible and detectable and therefore tangible for exploration. In addition, the taxonomy might be useful for other research initiatives in the context of knowledge definition and interpretation.

2. A comprehensive Interview structure – The specific interview structure was designed to allow a comprehensive view on the complicated problem at hand. The actual combination of the "General Opinion" part and the questions within the "Structured Interview" resulted with improved knowledge. In addition the actual incorporation of the taxonomy oriented "Guided Interview", resulted with high quality "in focus" results. This mixture of interview "Building Blocks" might be useful in other research activities.

6.2.4 RESULTS INTERPRETATIONS and ANALYSIS

Considering the overwhelming amount of data gathered during the interviews, the answers were coded into defined parameters. This approach had the obvious advantage of supporting a reliable process of data *interpretation* and *analysis*. In a more general view the various "Codes" introduced in the empirical research might be useful for other research activities beyond the MR specific context.

Chapter 7: FUTURE RESEARCH RECOMMENDATIONS

This research can be considered a good starting trampoline to future research. Two groups of future research possibilities will be briefly introduced:

1. Research recommendations in the discipline of Business Management.
2. Research recommendations in disciplines beyond Business Management which will be referred as 'General Research Recommendations'.

7.1 BUSINESS MANAGEMENT RESEARCH RECOMMENDATION

1. Intensive research regarding the EKEM model with the objective of obtaining a practical set of tools for reliable employee evaluation. This research will require an "In House" empirical research in a R&D department of a HT company.

2. Empirical research in the context of 'Knowledge Management' with focus on "Tacit Knowledge Management through Employees". The idea is find ways to manage the "Key Employees" in such a way they will be willing to share their knowledge in practical terms of the required performance, namely the actual R&D process. This kind of research is based on the premise that the "Crucial Knowledge" of the firm resides in a small group of "Key Employees". The results are expected to introduce adequate "Job assignments" and "Task Assignments" (Tasks assigned within a given job assignment) which will inherently contribute to tacit knowledge implementation and perhaps even knowledge transfer.

3. Research regarding the main strategy of the firm in the context of "Human Capital". This research is expected to address the existing difference of opinion about the importance of the R&D activity in relation to the Marketing activity. The notion that marketing is more important because it "Brings the Money" while R&D is problematic because it requires significant investments, should be considered obsolete. The main idea is to prove that R&D is equally important to Marketing, considering the obvious fact that R&D is the ultimate source of innovation. Having this idea in mind, the "R&D Human Capital" should be considered the most important asset in HT firms. The research is expected to offer a model based on the above approach and detect the basic views and objections of senior managers in the HT industry. In the best case such a research will be able to offer a more adequate model of general strategies for HT companies.

7.2 GENERAL RESEARCH RECOMMENDATION

1. **Extra Disciplinary Knowledge Research** – It is recommended to initiate research activity regarding the EDK parameters introduced in the MR' Taxonomy. These research activities should explore the possibility to design 'Training Programs' for each EDK parameter. Success in this area can lead to significant "upgrading" of employees in general and R&D employees in particular. In a broader scale, these training programs may be integrated in general education programs. There is a present research activity in this area regarding 'Creativity' and 'Analytic Ability' for example – these studies assume that although these skills are considered "Natural Gifts", they can be improved by further education/training.

2. **Artificial Intelligence (AI)** – This discipline is an active area of research since the seventies (1970 to present) and resulted with endless false interpretations of the extraordinary challenge of implementing a true AI. A comprehensive introduction of this complicated discipline is beyond the context of this thesis. However there is a possibility to examine the implementation of some EDK parameters in a "Thinking Machine".

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