

The Management of Personnel Collaboration for the improvement of multidisciplinary projects

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Abstract—Which perception keys of multidisciplinary team members' collaboration would assist engineering project leaders in decreasing its performance variability? The study of leadership and psycho-sociological tools in the labour-knowledge field makes it possible to produce a synthetic typology of team members' profiles, adapted to the team's design aim depending on the stake, the role and the crisis condition in the organisation. In order to model the effectiveness of the team, the methods of team member reliability measurement are linked to the profiles of the team members in relation to the crisis context of the project. The research analyses the performance of the model applied to real projects in companies, with a particular emphasis on innovation.

Index Terms—psycho-sociology in labour, project management, multidisciplinary team, team member collaboration

1. THE PROBLEM OF TEAM MEMBER SELECTION FOR A PROJECT

TODAY a major stake in companies remains the selection of the team members for a project.

Good collaboration between the members of the multidisciplinary team has become a very significant concern of the project leaders. But, as presented in part 2, psycho-sociological knowledge reveals a too wide diversity in peoples' profiles, and team leaders, particularly in the industrial field, are not familiar with the complexity of the management of team member collaboration (Mintzberg (1,2), Hacker (3)). Moreover, the particular context of the daily tasks in design or innovation projects corresponds to a crisis generated by the pressure to find rapid solutions, and in the difficulty of understanding between different specialists. In our research area (industrial management), we analyse data from the actual work situation within companies in which we have part-time contracts as project co-managers. So our research method is a qualitative-quantitative mix with data analysis from small observation panels of these companies and large-scale confirmation in other cases. We stop the data validation at the beginning of the saturation phenomena,

respecting a beta-binomial model, and crossing internal observations and validations (in the workplace) and an outside theoretical approach (as presented to the Academy of Management, Lepage (4)).

The most frequently-asked questions by project managers, even those with good skills in human-resource management, are mainly concerned with establishing team-member profile and selection of personnel based on very simple assessment tools (less than 5 characteristics measured).

From this large range of complex tools and methods, the question of correct usage by project managers with an engineering education is posed and discussed. This is compared with newly-emerging global approaches in the art of management (end of part 2). Before stating the need to design a description of a team member's profile from the expectations of the user (part 3), we can define our problem: to develop and validate a typology of people and to make prognoses about their performance in different situations; this, in turn, may help project managers to select suitable personnel for different projects and to adopt the appropriate style of management.

At the beginning of part 4, we present the validation of such a concern in multi-disciplinary projects in companies. Then, at the end of this part, validations are commented upon with regard to the extension of their application in innovation.

2. AVAILABLE KNOWLEDGE CONCERNING COLLABORATION IN A PROJECT TEAM

2.1 Psycho-sociological basic tools in labor field

We began our study on psycho-sociological tools and their implication in team-working. A range of topics from the work of 91 authors in the field, has been selected by the INFFO Centre (European Association of Researchers and Professionals in Human-Resource Management, La Défense, France.), from which we made a bibliographical verification. This data was mapped in 15 groups by the affinity-diagram method (K.J. method, Jiro K., (5)), in which we proceeded to structuring the topics with the research-team (experts in psychology and sociology of labour and project managers). We

designed: humanistic approach, sociology of labour, the sociology of change–management, individual collaborative behaviour within the group, game theory, psycho-analysis, theory of the features of the personality, transactional analysis and neuro-linguistic programming, acquisition of representations, socio-cognitive approach, cognitive dissonance and representations, cybernetic approach, systemic approach, behaviourist approach, neurology, neuro-sciences.

In order to present these fields, these headings are gathered in 6 visible roots in figure 1, below, in which the headings at the bottom are the oldest and, those at the top, the most recent (in order to give only a synthesis, we do not mention any of the authors in detail, neither do we make any reference to them).

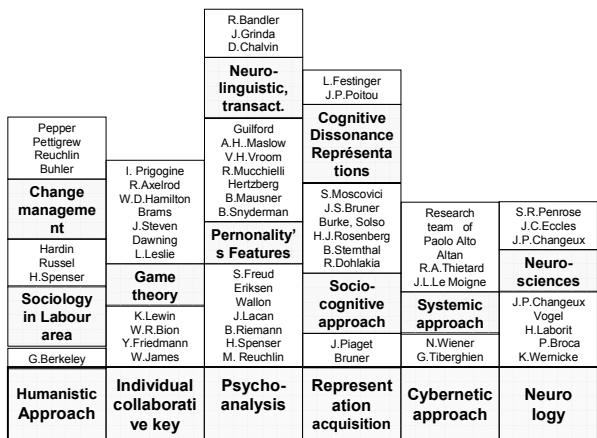


Figure 1, psycho-sociology mapping, Lepage, 2000

The six roots were named from left to right: the social approach, the interpersonal system approach, the introspective approach, the training approach, the informative approach, and the perception/action approach. However, to conclude this analysis, we have to take into account the criticism of sociology and psychology levelled by some of their own specialists. We discovered also that great developments in the knowledge of human perception are now possible thanks to Eccles (6) Penrose (7), Roth (8).

2.2 Criticism and improvements by the experts

Criticism indeed, of the least-rigorous practices of psychology and sociology in organisations is made by Le Goff (9, 10) in his publications “The myth of the company” and “The illusions of the management”. These highlight, according to the researcher J. Legomte (11) the ill-considered practice in organisations in the use of such methods as Transactional Analysis, Neuro-linguistic Programming and “use of the right/left

brain” of Doctor Hermann (he himself was considered a ‘guru’ of staff-management in an American multi-national firm, popularising the research methods, already quoted, in neurology and perception). We have a focus on these methods because they are frequently used in Europe in the selection of people for employment (Levy-Leboyer (12) and Bruchon-Schweizer (13) demonstrating the poor reliability of profile assessment of employees being taken on by companies). Our data analysis of company practices converges with that of the European association of human resource managers, as related by one of its members (Levy-Leboyer, (12)): “the managers learn (basically) these methods in a quick complementary formation, or looking at recruitment practices in their society and apply themselves in all kinds of management situations”.

So, our hypothesis was that most of the project managers use these methods because they are in vogue, not personally able to find methods applicable to personnel collaboration and not used to searching for new methods. As authors (Hacker (3), Levy-Leboyer (12), Le Goff (10) confirm that this practice was observed in all the companies we visited, we carried out supplementary bibliographical research on the underlying principles of new disciplines linked to psychology.

Indeed, we can appreciate the great progress made in the study of the conscience, from the irrational theory (Bergson 1928) through the neuro-linguistic approach (Dilts (14)) to the wholly scientific approach of John C. Eccles, S. R. Penrose in 2000. We can complete this scientific understanding with an ontological and ethical consideration when reading Maturana, Varela and Roth (15, 8). They explain the biological aspect of the self-organizing systems with an interdisciplinary approach and a philosophical caution from the “radical constructivism” and “cognitive” research fields. Also, the sociological approach leaves the traditional knowledge of inter-personal relations to explain communications exchanged between people in charge of design (Jeantet (16)) and scientific approach in philosophy (Prigogine (17)) and psycho-analysis (Cyrulnick (18)). Let us summarise, without presenting in detail, the work of neuro-physicians like Rosenzweig, Bennett and Diamond (working in 1972 on acetylcholine as a factor in the improvement of the stimuli to concentrate on minding), nor those of Schulz and Ahissar (Weizmann Institute (19) laboratory in neuro-biology (2002 – 2004)), by specifying that current research improves knowledge of psycho-sociology and especially, increases considerably the reliability of the results of analysis of personnel profiles.

Thus, hopefully, this new knowledge, available to companies, will reduce the current level of variability which has been estimated many times by Levy-Leboyer (12) at more than 57%. This is

absolutely unacceptable for an industrialist whose aim must be to reduce its variability to less than 10%, to reach (by definition) a satisfactory outcome. In spite of these sound developments, complexity still remains too important a factor for its application to be undertaken by an industrial manager who is not a specialist in psycho-sociology.

Also, more important than the irrelevant use of simple but unreliable methods of psycho-sociology and the difficulty in applying recent work in neuro-science, both of which may be within the knowledge of project managers, we made the hypothesis that global management could offer them surer methods which are built on experience.

2.3 Collaboration and leadership

We already knew in 1960-1970 from Fiedler (20) about collaboration and leadership in his contingency theory ("leadership effectiveness depends on both the leader's personality and the situation. Certain leaders are effective in one situation but not in others"), and from Vroom and Yetton (21) in their contingency/situation theory (about 5 styles of leadership in decision making). But these concepts relate only to the subordination of human relations in task coordination by a manager who has some leadership skill, without taking into account the crisis situation arising from the context. The contingency theory has been criticised, chiefly because it depends on many different situations, without the general synthesis which we seek in our research.

We also knew from Mintzberg (1, 2, 22) about leadership. He shows that organizational design is a major input in leadership creation for continuous improvement. But, as it is true for global organization, it is not deployed in the same conditions in projects (they are self governed). The same can be observed about his analysis of failures in organizations due to lack of leadership in managers. Indeed, is what is true for global organisation applicable to projects where individual working practises are often independent of global organisation and culture? Here we make our research assumption, concerning the quality of the deployment of values, goals, and targets in a top down management with simple declinations towards the efficiency of tasks in projects taking into account the qualifications and competencies of each team member. The Total Quality Management, generally applied in the companies with which we were associated, is supposed to make correct use of this deployment (Hacker, Roberts (3)). But do all the organizations reach a high level of quality? When Pich, Loch and De Meyer (23) show that project management is made up of uncertainty, ambiguity and complexity?

Another piece of research about leadership, most closely linked to our subject was presented

by Jens Dahlgaard (24): principal typologies of leadership governing the attributes of collaboration between the team members and their managers at work.

From 2001 to 2003, his team at the University of Linköping in Sweden questioned many heads and employees of European companies on the different leadership styles of the managers, acceptable to the team members in the workplace.

This questionnaire was carried out by consultants, specialising in assisting with the recruitment and evaluation of the potential of managers for companies throughout Europe.

The synthesis obtained from the vast quantity of data which was collected reveals the existence of 8 principal profiles of leadership concerning project heads and managers:

- the task orientated: a persistent, analytical, economical, leader who doesn't accept mistakes committed either by himself or other people and who doesn't listen to others very much;

- the creative: a humorous, visionary, effective, ego-driven leader, who masters many creative tools, and may be often courageous, but one who may be impulsive and becomes involved in conflicts;

- the strategist: a purposeful leader, one who has a long and middle-term view on the project as a whole, who seems to be process orientated and trustworthy;

- the captain: a competent, open, reliable and trustworthy leader, who listens readily to others and can be a good and very forceful communicator.

- the specialist: an expert in his field and calm in appearance, but one who could be pedantic and uncompromising, very resistant to change and preferring to work autonomously.

- the involved: a humanistic and empathetic leader, who listens to employees, but doesn't delegate and focuses on routines and procedures;

- the impulsive: an enquiring, actively-involved leader, one who is actively concerned about the working environment and is ready to accept change, but who is also one who takes risks, who is autocratic and domineering;

- the team builder: a tolerant, inspiring leader, one who gives feedback, support and motivation to the team members in his role as coach.

The research team commented on the interpersonal relations which existed within these profiles, and between the leaders and their employees. These provide a choice of the most effective leadership profiles, very interesting for global management, but not successfully adapted to projects, as we learned when testing it. Indeed, we observed that such personal profiles shift from one to another when difficulties arise in a project. For example, at the beginning of a project, a "team builder" member could have fair relations with others. At the project review the C.E.O. could impose to hardly react (cutting

delay and costs). The "team builder" often becomes a "task oriented" controlling people and making targets hard to follow for his team members, generating bad interpersonal relations. So we need to classify the members in more global profiles remaining stable when the crisis context of the project increases.

We could comment on the new approaches to change management (Hacker, Roberts (3)) with a great concern for project management, but as shown by Dosi (25), it is difficult to measure the changes and their bearing on economic targets. What tools and methods would be used in this measurement? It is perhaps more efficient to look at the very recent arrival of a practical approach in interpersonal relations. Indeed, the psycho-sociological intervention, (G Mendel (26, 27)) is particularly interesting in order to understand the phenomena of power, stress and crisis in the teams, at the heart of our problem. It looks again at the various branches in this field by analysing their effectiveness in operation:

- The organizational approach;
- The sociological intervention;
- The "socioanalysis";
- The socio-psycho-analysis;
- The psychodynamic one;
- The psychoanalysis groupware.

Unfortunately, as he stated, none of these 6 methods is applicable to a head of project, and none of them is really reliable. Moreover, without an easily applicable and relevant method being available to the team management, we had to create our own model of team member collaboration, driven by the requirements of company managers, and as presented in part 3.

3. THE PREPARATION OF A USER ORIENTATED MODEL

3.1 Elaboration of a model of a team member's profile

There being few people working in psycho-sociology who are specialised in the field of behavioural studies of team members in a project, we proceeded to seek answers from complementary authors. The philosophical discussion about the emergence of neuroscience (Ricoeur (28) and Changeux (29)) opened our minds to further observations concerning the behaviour of team members. The need to manage personnel (for a head of project) involves making a choice of profile of the team members, (which main categories of profile?) depending on the technical nature of the project and especially with regard to the psycho-social configuration of the team in the organisation, at the same time taking into account the perceived professional and personal life-styles.

3.2 Linking team member reliability and crisis condition.

The difficulty which arises here is the

measurement of motivation, which is a global, vague, multidisciplinary concept, which generates many tools and approaches, but which is dependent on expert opinion, (in the specialism). But when we have a sample of team members (in a large company) facing the same choices, we are able to establish the ratio of the number of tasks which are accepted, divided by the number of proposed tasks and to use this ratio as a probability of motivation, in an average targeted population of team members. The experimental enumeration can be carried out by the panel from records of similar situations experienced by a team member in his work history on multiple projects. Executives in charge of personnel (research management, design management, human resources management) can take this historiographic approach by the use of these records or by using log-books about the progression of the projects (daily return of the positive and negative events: seldom used, but extremely effective).

Hereafter we can see what was structured in an affinity diagram, with data from level zero to level 3 of abstraction: level zero: that of the perceived, exchanged, tools used between the team member and an appraiser; Level 1 of abstraction: that is equivalent to the headings of our cartography in psycho-sociology (figure 1); Level 2 of abstraction: that is equivalent to the branches of our cartography in psycho-sociology (figure 1); Level 3 of abstraction: that is equivalent to some of the required categories of standard profiles of the team members (to be defined in our research).

3.3 The concept of reliability of a team member.

Here we take another look at the original definition of reliability, to adapt it to the team member in the project. We take the concept of quality as "professional qualities of the team member", i.e. a capacity to fulfil the task which is allotted to him. The qualities of the team member enable him to carry out the task and, at the same time, the quality of his work is at 100% when the task is completed. The quality of work would be x% if he carried out the task X times out of 100 times. In the other cases, he refused or failed to meet targets (results below expectations). The x% calculated is a probability of the successful completion of a task, and therefore of reliability. To define clearly and definitively the concept of quality/reliability of a team member, it is better to retain only the definition of reliability (probability of fulfilling a task between the moment t and t + dt, knowing that between 0 and t it was fulfilled), and of subsequently adapting it to the team member in the project: reliability of the team member = probability that a team member fulfils his task in a given time, mindful of the fact that we know how he and his counterparts carried it out previously.

3.4 The concept of a state of crisis

We can observe the "professional post"

according to current practices in companies, the evaluation being measured with tools available to the worksite. The setting of targets in an organisation depends on the level of the allotted role, and the setting of targets in the strategy on the stake for the task. This allows us to combine role and stake to constitute the state of crisis with the same tool used in the observed post and the team member's capacity evaluation to take responsibility for the job at the post. We can show an example measured in 3 levels (1 = weak, 2 = average, 3 = strong), in which the state of crisis can be measured by multiplying the two preceding measurements, from 1 to 9 (see figure 2). This is not a mathematical curve, but a picture in which we can see a synthetic mental representation of a work-station classification using 4 characteristics (stake, role, experience and competency which frequently happens in companies working site assessment, but the last two are irrelevant for our research).

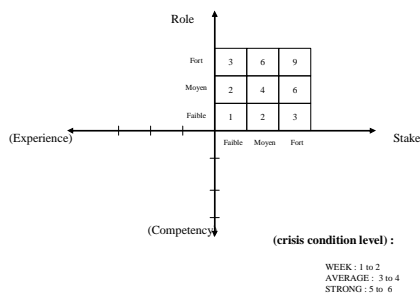


Figure2. Example of working station assessment with crisis condition classification

As we used this tool because it was available in the companies observed, we had the question of its efficacy compared with other concepts of work-station team performance measurement. Leung, Chan and Lee (30) show one of them, but they describe the role modification (balance) when the internal project organisation is changed with regulation of work composition adapted to missing or changing tasks or personnel. Fisher, Hunter and Macrosson (31) analyses testing methods of classification of individual team members' capacities, including their performance, particularly in a team involved with new products. This very interesting approach, combined with the well known practices of the Belbin method in individual selection and motivation for team building, is very well focused on our research subject, but not particularly adapted to take the crisis condition into account.

We could now start the construction of our model. We understood, by studying the affinity diagram, that it will have two axes of dynamic representation of the evolution of the profiles: one axis for the reliability of the team members

(from 0% to 100%) and the other axis for the "crisis condition" (from 1 to 9). Subsequently we give the results of the upper level of abstraction.

3.5 The person involved in management.

This is a very frequently- observed profile in project teams, both in industry and in other spheres. Its effectiveness does not often attain 100% because of its inherent failures and drifts, but it does not fall below 60% because his sense of responsibility would prevent his giving up the task. The manager likes to be involved in moderately-difficult projects and is not at ease with tasks which are either too simple or which involve unreasonable risks.

3.6 The courtier

We can define this profile as one who is more inclined to represent his company, and its project, and to communicate in situations where user-friendliness, courtesy, the ability to assume the leading role, the ability to be diplomatic, rules and traditions dominate. He dismisses the idea of even considering the undertaking of any very difficult task himself. He also usually refuses to take responsibility in times of crisis. He does not like to be involved in the long term with a team that has responsibilities.

3.7 The pioneer

This rare profile (less than 2% of manpower in normal organisations) is seeking for the "impossible mission" and sometimes the "extreme action". He sees the risk rather as a promotion of his perceptive capacities, as opposed to "normal" managers who would consider it as inhibiting their capacities. If images of highly-successful "final missions" come to mind, either from past experiences, or from envisaged future possibilities, he will undoubtedly lose his ability to listen and to discuss amicably in a standard context, thus affecting his reliability.

We graphically represented the analysis of these three profiles and their reliability according to the crisis situation on the model, figure 3, below:

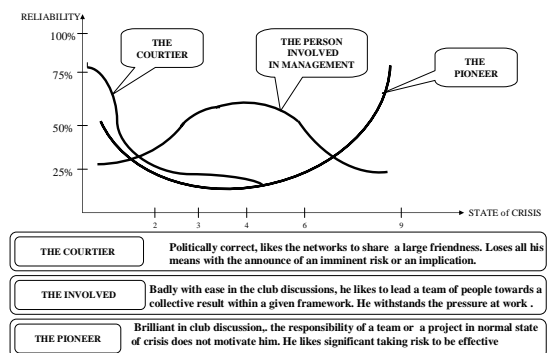


Figure3. Evolution of the three profiles according to the state of crisis

4. VALIDATION OF THE MODEL IN COMPANIES

4.1 Different validations of the model in projects

The validation was carried out in three stages, starting with a series of interviews of those in charge of organisation, of human resources and projects, according to the method of collection of factual elements named "the voice of the customer" (Griffin and Hauser (32), Lepage (33), Shiba (34)). We questioned three university professors of sociology, two of psychology, three researchers in human resource management and nine heads of industrial projects or C.E.Os. of companies

Then a "Kano" questionnaire (35) was drawn up starting from the synthesis of the first returns and was addressed (in 2001) to more than one hundred managers of companies, heads of project, including all sizes of organisation and in all economic sectors. See figure 4 the synthesis from 98 returns concerning a panel of Human Resource Managers. We can see that the HRM modified the model allowing more reliability to involved person in management in low crisis level, and less reliability to the pioneer in low crisis level. The results have been confirmed (2002 to 2004) with more than one hundred other company panels (measurement reliability 97%).

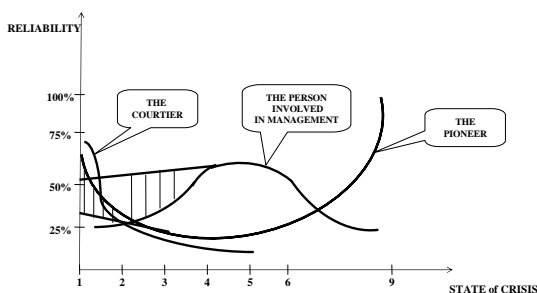


Figure4. Modification of the model by the Human Resource Managers

4.2 Discussion and extension to creativity

The outcome of this research offered a model which could finally be classified in contingency theory, because working sites and personnel profiles are assessed in each particular situation within in the companies. So, how effective is our approach, if this contingency theory has been largely criticized? We have shown in part 3 that our approach is a synthetic one at a 3 or 4 abstraction level in the area of detailed tasks, designed by many different managers in different situations, being relevant to each different case and producing the same result: in a global profile for each common case of crisis context. The validations show that the approach links the 3 synthetic profiles with the crisis condition in a

reliable relation, independent of the situation.

We now extended our research, focusing on innovation projects in companies, asking ourselves the following question: "Is it opportune to preserve our typology of three profiles in the case of projects of innovation under various states of crisis?"

The state of crisis here corresponds to the need for maintaining a strong long-term vigilance and at the same time a sound capacity to perceive clearly customer expectations and solutions. This is what is shared between the managers in the context of a true-to-life working situation. Darses (36), Lundin and Midler (37) think that it would be a quite easy to share ideas, but it's not been the case in most of the companies observed. It is a question of fully engaging the personnel and to concentrate, throughout the meeting, on one subject at a time, focusing on the production of ideas and the prompt response to the proposals of the other team members.

This context, which is a crisis one, has been studied (Lepage (38), 4) in research working connected with innovation projects in 3 multinational companies. In these case studies the crisis situation is, like in most of the examples, more serious than previously stated because of a second state of crisis, replacing concentration and vigilance phenomena, which is power competition between specialists.

Concerning the creativity tools, always employed at the heart of innovation projects, we naturally extended our research as the question, frequently-asked by our industrial partners, is "Could we have a correlation between the creativity tools used in our companies and the 3 managers' profiles of our model?" As it has been shown in the innovation projects of the companies observed, we found three major creativity tools: brainstorming in "focus groups", the TRIZ method, used by one or two managers in a topic, and 'One on One' interviews of personnel (coming from the "voice of the customer" method (32,33)).

With regard to the first, many studies confirm the pointers required to ensure the success of this method of stimulating creativity: to have a talented animator (impossible to circumvent); to select personnel with "open" personalities, to ensure that participants are totally concentrated on the topic under study. Some negative points have been observed and explained by the psychologist Moscovici (39):

- the "isolated" participants, those excluded from the project at the beginning of the creativity session, remain frustrated until the end of the project and, often, prepare solutions in isolation from the group which they 'slip in' at the end of the presentation of the other principles of solution, adopted by the "focus group";

- the solutions of the "isolated" members, often drawn from previous studies and adapted for the new framework, produced the best solutions in

85% of the cases.

-the arrival of classified "open profiles ", as external elements, closed to the internal profiles, generates a self-segregation, not openly-declared but deeply felt as severe stress, and frustration.

We made the assumption that it would be more efficient to make all the personnel take part in creativity, so we analysed the productivity ideas of the three profiles in the focus group versus the creativity tool, beginning with the focus group:

-the involved person in charge, is ill-at-ease (at the beginning) in the "focus group". He wants to give his opinion in terms of the feasibility of the solutions coming from the others.

-the pioneer can be extremely productive and brilliant but must "be taken in hand" by the animator because he easily-becomes an arrogant leader, preventing the other members of the team from expressing themselves.

-the courtier is at ease in the "focus group" because he sees the situation as a friendly discussion.

Concerning the 'One on One' interview, the method is valid for the three profiles, knowing that:

-the courtier needs to be somewhat driven (by the questioner) towards the factual events that have to be described. The rhythm of the interview will resemble a mild interrogation;

-the involved person in charge will be rather inclined to dismiss his experience in favour of adopting the new ideas (although the reliable elements of past/present are maintained).

-the pioneer will have to be motivated by a constant pressure. It is necessary to make the interview factual giving very short questions to keep the person focused on the present projects as he always likes to be allowed to speak about ideas which are too far into the future.

Finally, we also had the opportunity of a trial with the "TRIZ" method (Ideation (40), conceived by G. Alsthuller, allowing a single participant (or two or three) to work on the analysis of previous ideas on the subject, to study and to modify them. This method is better suited to 'the involved person in charge'.

We can already describe the major result of these experiments in 3 companies: with the three creativity tools offered to the different profiles of the team members, we allowed all of them to participate and we observed more than 30% ideas production increasing. As we are now in the process of making this validation, we will soon be able to present our complete results, but, at the moment it is simply a qualitative description of this unfinished extension.

5. CONCLUSION

Industrialists' experience of the difficulty to apply the psycho-sociological tools available incite us to observe the experiment of more global leadership profiles to describe human beings of team members in project. But the

stability of these profiles under different crisis conditions remains an assumption which leads us to design some stable ones at a more global synthetic level. As presented in part 3, the synthetic team member's profile, according to the state of crisis, has been validated in many different projects.

Now, it is possible to quantify the validity of our method with much more precision. Indeed, the new results, obtained in companies, on new achievements in projects of innovation, between 2003 and 2005, allow us to extend our three profiles model. In particular, the number of returns obtained and the factual nature of the information recorded by interviewing the participants in a multitude of projects of innovation, already enable us to confirm the validity of our model. And, now, the whole panel of correlations which appears between the 3 profiles and the skills of the various specialists working in the projects allows us to increase the reliability of the ideas productivity measurement. So, we are beginning to work on the concept of "maximum speed in discovering product / service solutions". We are doing this to obtain more new solutions of product/service, thanks to the convenient adoption of the good creativity methods for the team members' profiles according to the state of crisis. In particular, we are beginning to ask ourselves various questions about the impact of the concurrent engineering approaches (36) in team member collaboration in multidisciplinary projects:

-which abstraction level to choose in the exchanges between specialists?;

-can the crisis be wanted and controlled?;

-is it necessary "to enforce" the good practice in methods of stimulating creativity in order to improve the productivity of the teams, or to leave a freedom of choice to the team members and to observe the effectiveness of the team?

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