World Wide status of TRIZ perceptions and uses

a survey of results

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The purpose of this report is to give the reader an overall view of the state of uses and practices in the Theory of Inventive Problem-solving (TRIZ), which has been present in highly industrialised countries for the past two decades. Our methodology involved full use of an Internet questionnaire, the modalities of which shall be described in further detail below. The European TRIZ Association (ETRIA) was behind the initiative for the survey.

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Introduction: the importance of taking stock of the situation

Aims & Scope of this project

Since TRIZ was created, and up to the mid-1990s, activities centred on TRIZ have constantly developed under the legitimate impetus of its principal creator: Genrich Altshuller [1]. Mainly located in and around the block formed by the former Soviet Union, various educational and research centres, and public and private establishments have worked on the development of TRIZ based on the fundamental principles developed by Altshuller. A number of new theories, operational techniques and application tools have also been engendered.

As our objective is not to offer yet another vision of the history of TRIZ in the West, we shall start with the following postulate: TRIZ has broadened in scope over the last two decades spreading to highly industrialised countries, and as such, an inventory of its scope would appear to be necessary at this juncture. We should add that a certain ambiguity remains about the work of Altshuller: in an industrial world where a number of theories have come across the stumbling block of structured methods and tools, and where methods and tools come and go as passing fancies, TRIZ seems to have made its mark in a permanent fashion and it does not look as if it will fade away in the near future.

Members of ETRIA's board of directors therefore thought the time was ripe to try and understand why this acronym persists, despite all the faults that can be found with TRIZ, and why it has become firmly rooted in our industrial and educational landscapes, and so to take stock of how TRIZ is perceived today in the environments in which it is used.

The European TRIZ Association was founded in 2000 and has worked since then to share new knowledge generated on the subject of TRIZ, in particular through its annual publications and exchanges in the annual TRIZ-Future conference. Its structure makes it the ideal candidate to lead this type of project, since its non profit-making aim makes it void of any interest in targeting such or such a vision or school of thought concerning TRIZ.

This project also aims to inform the stakeholders of TRIZ, from all backgrounds, on how the theory is perceived today and how its content is used, in order to help those who are interested in its development to understand the expectations of users and to foster its evolution more effectively.

Architecture of the questionnaire

To make receiving a significant feedback from users a feasible proposition, it is common practice for a maximum of 20 minutes to be dedicated to filling in a questionnaire [2]. Within this time-frame, we know that the questionnaire must not

include more than 50 questions. Overall, the questionnaire was structured into 5 chapters of questions (Figure 1) with a total of 54 questions.

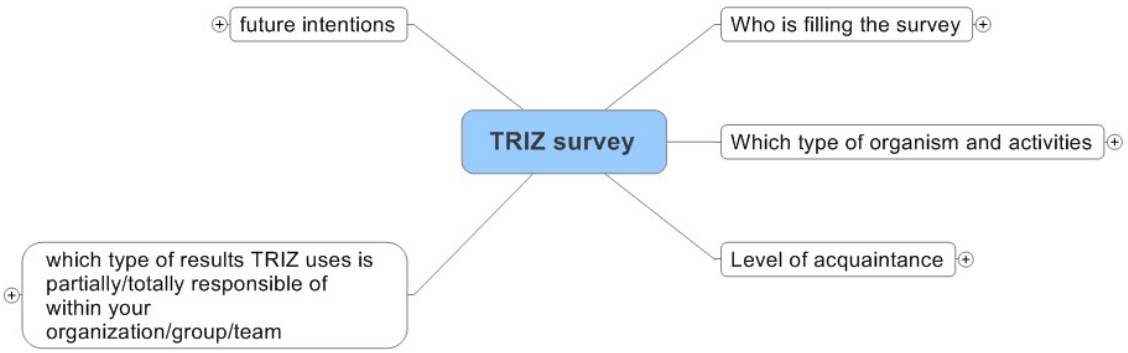

Figure 1: Overall structure of the questionnaire

The first chapter was devoted to information aimed at identifying the respondent and the structure for which he/she was filling in the questionnaire. In this category, we have also put superficial questions relating to the overall perception of the acronym TRIZ and what it evokes for the respondents and the other people in his organisation. Finally in this chapter, the respondents were also asked if their names and the name of their enterprise could be quoted.

The second chapter started with a question categorising the typology of replies (Industry, Consulting, Education and Research). According to the reply, the respondent was then directed to a series of questions specific to the typology of his organisation. We were therefore able to collate related replies: for academic backgrounds, on the typology of training and the teachers involved; for industrial environments, data on the projects in which TRIZ is used and the sector of business concerned; for consulting, the proportion of activity associated with TRIZ in expert evaluation.

The aim of the third chapter was to briefly determine the knowledge level and uses made of the best-known components of TRIZ. The respondent was therefore requested to qualify the scope of his knowledge of TRIZ for himself and for the other persons involved in his organisation; which components of TRIZ are used or not and their frequency of use; the origin and type of access to competencies associated with TRIZ.

In the fourth chapter, we wished to qualify the TRIZ-related results obtained by the organisation. To do this, we divided the questions into levels pertaining to the maturity of the results ranging from the idea to the product on the market, going through patents filed and situations where it was acknowledged that problems had been solved by TRIZ.

Finally, in the fifth and last chapter, our aim was to find out the organisation's future intentions in relation to TRIZ, the image it had retained from the theory, the expectations of users and any advice that could be given to existing TRIZ communities.

Methodology used to address the users

There are a number of methods which can be employed to take stock of the situation and capitalise on the data when conducting a survey. We decided to use an Internet questionnaire for the following reasons:

Today, TRIZ has achieved development on an international scale and the population polled must cover a worldwide spread. A face-to-face survey would be fastidious and require several years to be conducted with a broad spectrum of representatives. We also decided against phone interviews since the respondents speak several languages and phone appointments would have been problematic, not to say incompatible, considering the various time zones covered by the countries concerned.

The choice therefore fell on the method of using distance interviewing facilitated by the international cover provided by the Internet network and the acknowledged ease of access via a mere navigator. Regarding the capitalisation of captured data, we opted for an open source environment broadly disseminated and supported by an active community of Internet users: Limesurvey[1]. The user-friendly installation, interface and ergonomics, and the multilingual nature of its environment were also significant factors in our decision-making.

The principal faults which can be found with this type of survey still had to be addressed [3]:

Selectivity: since the TRIZ world is still relatively small compared to the scale of a far-reaching social issue affecting everyone, any reproach as to selecting a population of elite stakeholders having access to the Internet becomes null and void. Indeed, the immense majority of people practising TRIZ have access to the Internet.

The exhaustiveness and reliability of the source of the replies: for this aspect of the matter, we had to design a system enabling us to address a population which was both targeted and representative of the distribution of populations that today characterise the users of TRIZ. This system was set up thanks to the structure and the efforts of several international members of the ETRIA Association and beyond. Indeed, ETRIA boasts a panel of representatives in each country who are regular correspondents and frequently participate in the association's activities. We therefore decided to set up an initial circle of correspondents of 1 per country potentially taking part in the survey, on the basis of a network of people who know each other and have already been in communication with each other. The correspondents (see Table 3) were then invited to relay information relating to this project to their contacts in countries which did not

[1] http://www.limesurvey.org/

yet have representatives in order to cover a large number of representative countries known to practise TRIZ.

Out of 45 countries contacted through a representative, 34 responded positively to our request for cooperation within the frame of the project. Paradoxically, some countries remaining without a coordinator nevertheless replied to the questionnaire. In the end, 39 countries participated in the questionnaire. To make the questionnaire easier to understand and ensure that participation would not be restricted to English speakers alone, the questionnaire was translated into 7 languages: Chinese, Czech, Farsi, Japanese, Korean, Polish and Spanish (table 4).

As a result, we have received 319 replies from these 39 countries in 8 different languages (Figure 2).

Figure 2: Geolocalization[2] of responding persons

In our methodology, we also had to be sure that the distribution of replies reflected a representative balance of the landscape of TRIZ users for the country concerned. By distribution and balance, we mean a quantity that reflects the proportion of enterprises, universities and consulting structures within each country. The choice of these 3 forms of structure reflects the reality of usages made of TRIZ today, as well as a good number of other methods derived from theories. In our survey, the distribution for all the participants and per country gives the figure 3 representation.

[2] The positionning of dots is automatic depending on the name of the city associated to the name of the country. Some errors may appear in the display.

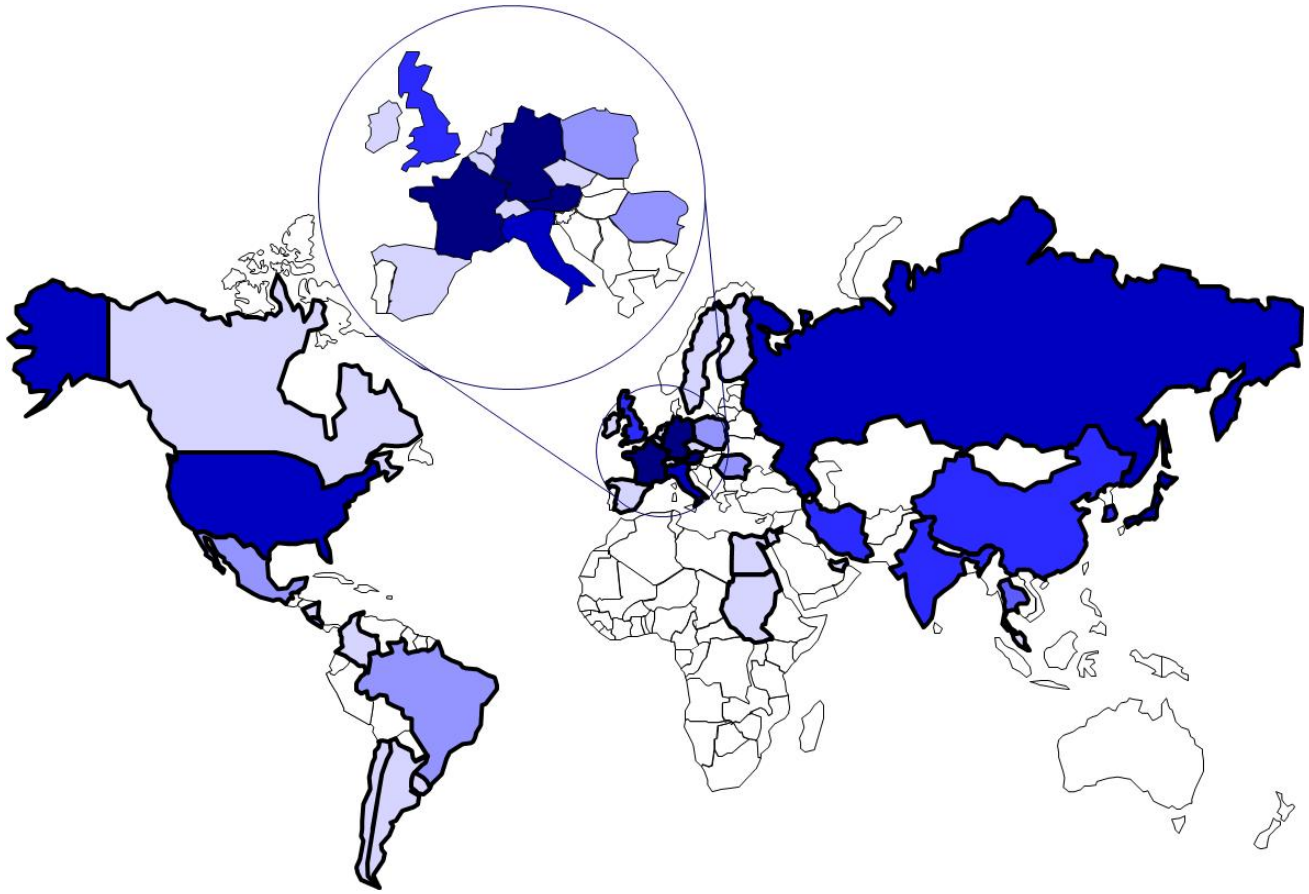

Figure 3: Density of answers per responding countries

Results analysis

Analysing the typology of the replies

An initial analysis of figure 4 shows that the highly industrialised countries are nearly all represented. From this, we can conclude that TRIZ is no longer a theory reserved for just a few countries, but has spread to all developing countries, to different degrees, and it seems to have followed a uniform path of expansion in the world. We should note for example, that the Sudan is included in the reply statistics through Gezira University. However, there appears to be a discrepancy in some countries committed to the project and the real situation of the replies collected. We notably wonder about the absence (or very low number) of replies from Australia and Switzerland. Finally, the two maps indicate that German-speaking countries (Germany and Austria) rank very high in the questionnaire reply rate and make up a significant axis of users that are well balanced in terms of the typology of TRIZ users (distribution between consulting/research-education/industry). We would also like to comment that the United States of America, India and the United Kingdom show a distinct domination of replies stemming from consulting and industry and a very low level of academic

responses (see figure 4). Russia too (TRIZ's country of origin) also shows a very low level of representation in terms of its industrial practices. But on the whole, as indicated in figure 5, this distribution seems fairly uniform when observed on an international scale.

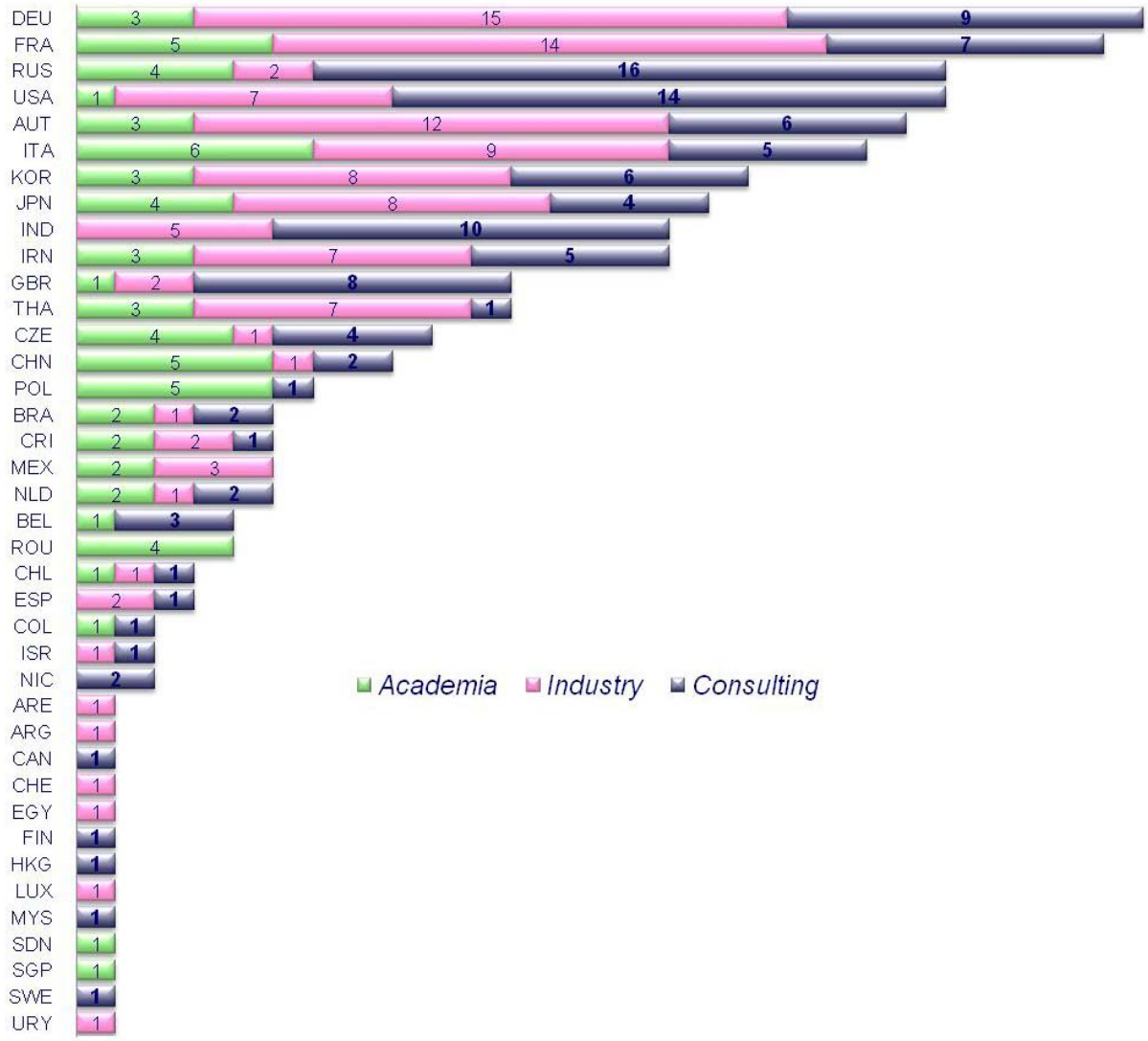

Figure 4: Histogram of answers' distribution per countries & per type of organization

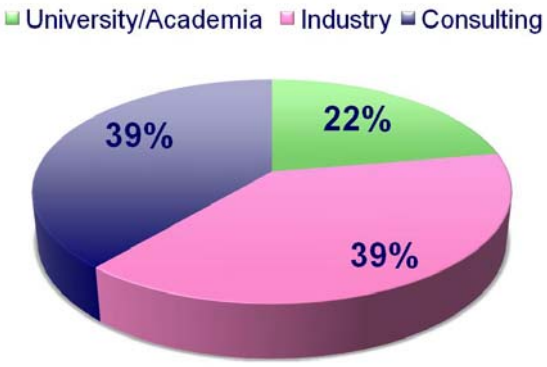

Figure 5: Pie chart representing distribution of organization typology

Analysing perceptions of TRIZ

Question 9 "How do you and the other people in your organisation perceive TRIZ?" gave rise to the distribution figure 6.

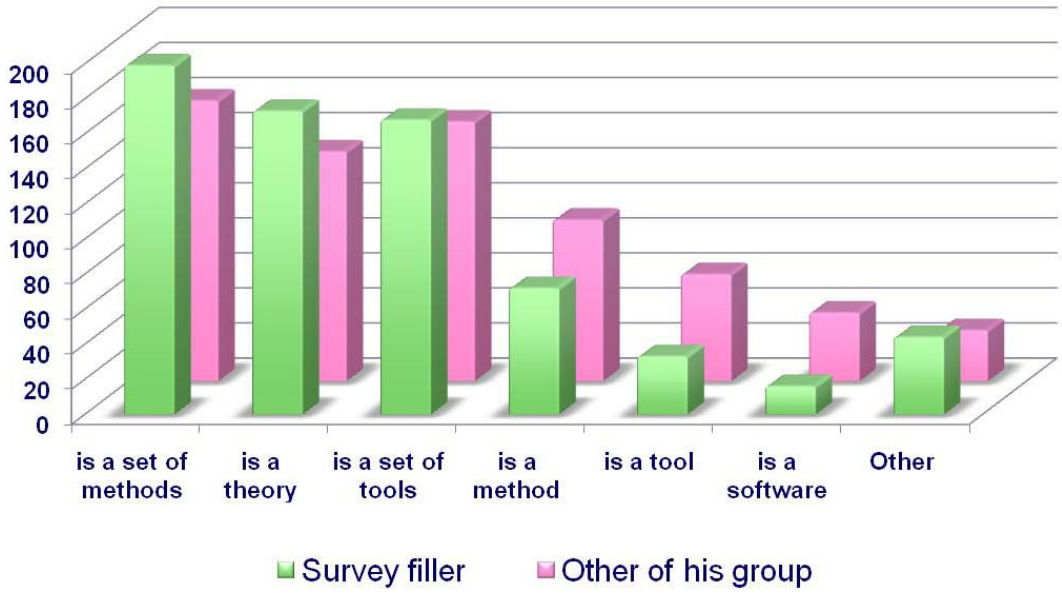

Figure 6: Histogram of answers for TRIZ perception

Several things can be observed on examining the graph above:

While it is put forward as a theory, TRIZ is mainly perceived as a set of methods. The reply "theory" only ranks second for the respondents, and even third for the other

members. We should note in passing, even though it is not the majority case, that 39 people (out of 319) thought that TRIZ is a type of software.

We then put in an open reply option so that the respondents could qualify what TRIZ is in other terms for both the respondent and the others.

Figure 7a & 7b: "Other" answers to define TRIZ

In figures 7a & 7b, we note that for 4 people TRIZ is a science, for 7 it is a philosophy and for 8 it is "nothing at all". Finally, some replies contained words and expressions bearing a negative connotation (see table 1). They are marginal, but are nonetheless a sign that negative perceptions of TRIZ are also a reality - even with people who have been selected and have accepted to dedicate time to the questionnaire. We can therefore easily imagine that for a broader population questioned at random, the percentage of negative perceptions would have been much greater. The fairly broad spectrum of open answers also shows a range of terms that leads us to the conclusion that TRIZ enjoys a confused and diffuse image, whatever the respondents' level of competence. We believe this is due to an absence of clear guidelines in the reference documents and the plethora of perceptions given in various sources (books, articles, courses, conferences, websites etc.) informing people about TRIZ. From this confusion, the beginner/learner must adapt to the heterogeneous sources of knowledge he has had access to and rather than opting for a single vision, he has built up his own reality and his own image of what TRIZ is all about.

Other ways to name TRIZ	Count
An evolving process	1
A set of skills	1
A Useless model	1
A school of thoughts	1
A discipline	1
An innovation tool to handle contradiction	1
A complementary methodology for Product Innovation	1
An attitude	1
A Set of Related Concepts	1
How many people so many TRIZ	1
A technology	1
Something to improve in Six Sigma	1
A set of theories	1
An attitude	1
A cult	1

Table 1: "Other" answers to define TRIZ

Techniques, methods and tools stemming from TRIZ and their uses

The first chapter contained a series of questions set in a table where boxes had to be crossed. We asked respondents a question on the frequency and knowledge of the components of TRIZ [4] [5] used. This question led to figures 8 & 9.

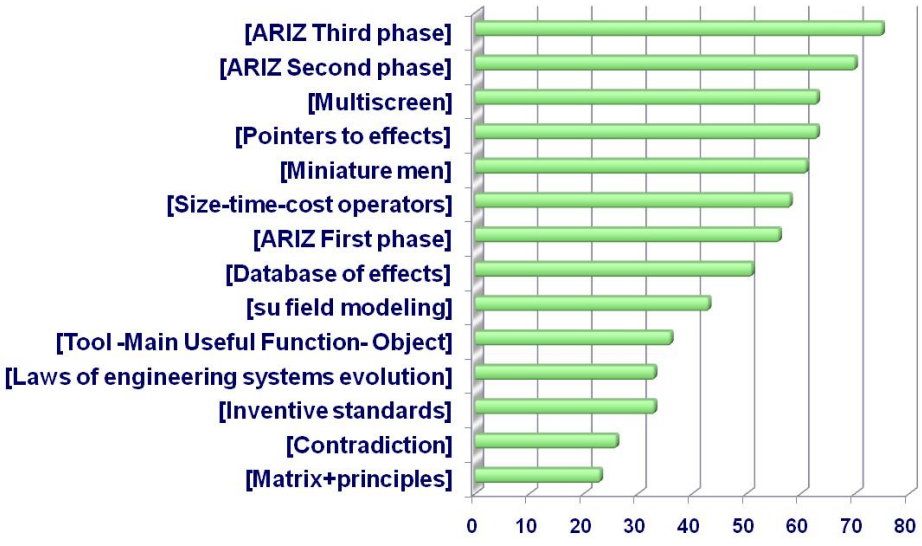

Figure 8: Frequency of TRIZ's main components: most unknown

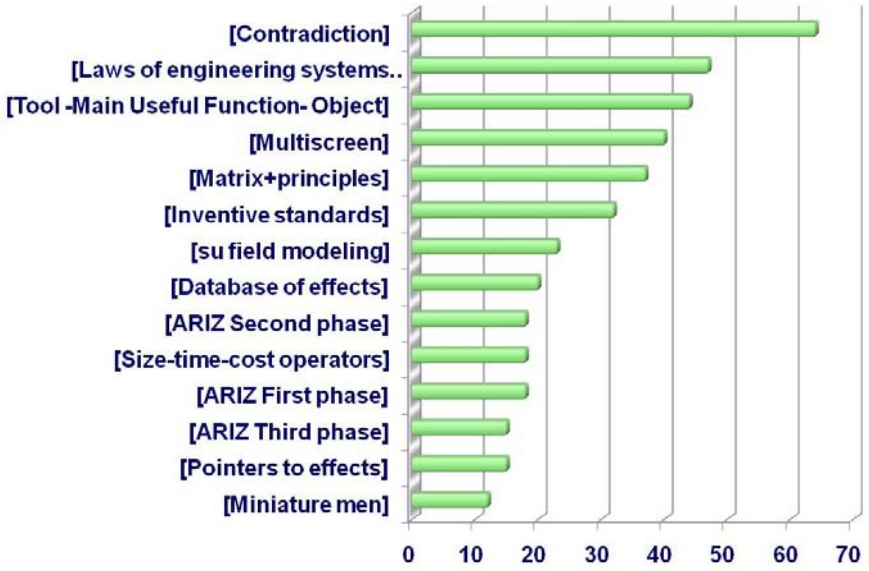

Figure 9: Frequency of TRIZ's main components: most often used

A quick analysis of the replies underscores two aspects:

The most used TRIZ tool is contradiction, followed by the laws of evolution, whereas the use of miniature men, ARIZ and DTC operators remains marginal. The matrix associated with inventive principles also stands in good stead as to the frequency of people knowing that it exists and using it on a regular basis. However, we observe a paradox in the multiscreen tool. Although it is well placed in terms of systematic usage, it is also one of the less well-known tools among the respondents. Concerning ARIZ, the majority of respondents seem to be aware of its existence without however knowing exactly what it is and its use remains very marginal. Finally, we should also observe that pointers and physical effects bases top the list in terms of components used occasionally, and only when it is deemed necessary.

In conclusion, we can state that 32 respondents claim that they do not know what the laws of evolution are, even though they form one of the fundamental of TRIZ, and that two-thirds of the respondents do not know about or have never used ARIZ, although it is put forward as spearheading the field and often qualified as "the most powerful" tool within the corpus of knowledge stemming from Altshuller's achievements. As a conclusion to this chapter, we think that TRIZ is still not widely known in terms of its content, including among people who today make up its panel of expert users to varying degrees. Should we see here a discrepancy between the effort required to master the content of TRIZ and the current capacity of engineers to dedicate the time required to the learning process? Or is it yet another sign of the lack of clarity of the content and how hard it is to access for the learner?

Section linked with academic circles: research

In the second chapter, the questions diverge according to the type of organisation. For the universities, our aim was to collect data on the make-up of teams and the forms of teaching TRIZ. Figure 10 gives us a reminder of each country and the size of the team of researchers.

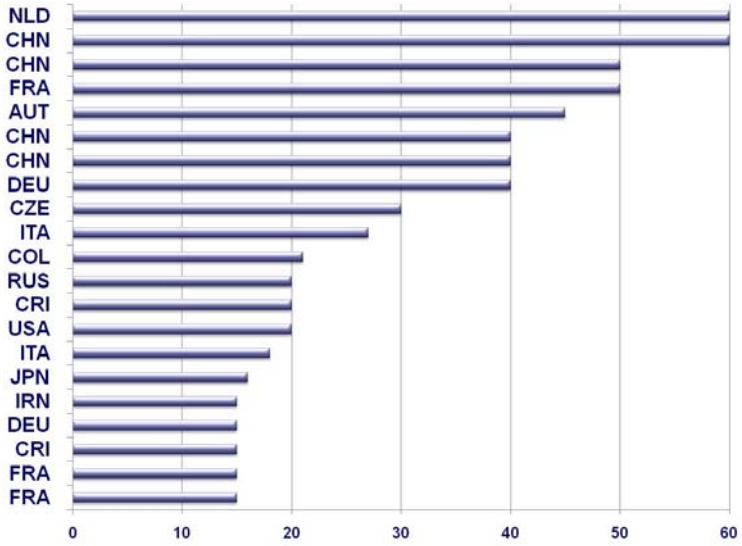

Figure 10: Countries and their research teams (Size) - top 30

Our first observation is that 4 of the 7 largest teams are Chinese. A parallel analysis of publications centred on the keyword TRIZ in databases of scientific articles shows that in 2009, 12 out of 19 of Rank A scientific publications around the world were Chinese[3]. The rest of this analysis confirms that Europe remains at the top of the leader board for publications if we look for the same data's since 2001, but its lead has been whittled down since 2007. The third focal point is South America whose growing presence in publication is not evidently reflected in the previous figure.

The typology of the research teams gives the following graph:

[3] www.**isi**knowledge.com *:* Search made on October 15th 2009, typing the keyword « TRIZ » and counting authors countries of origin.

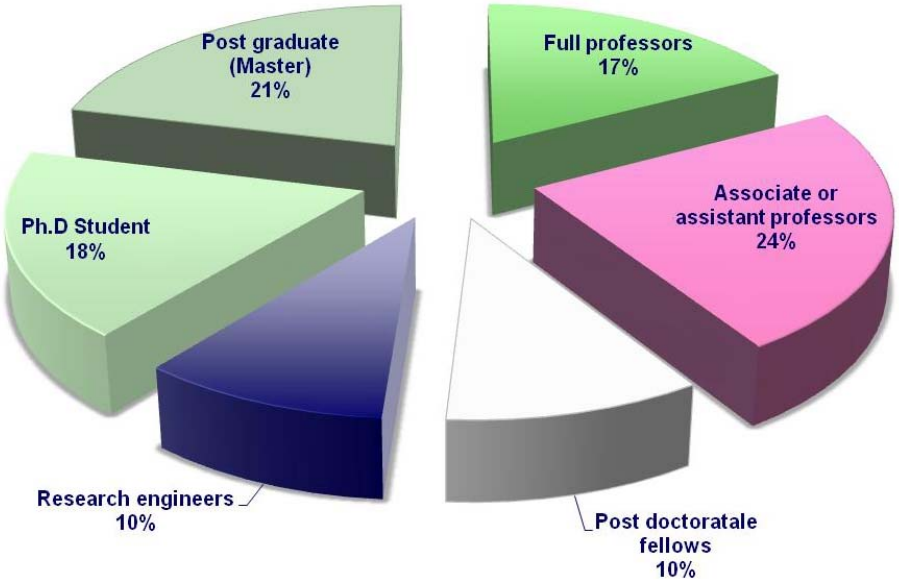

Figure 11: "Standard"research team structure

It is clear that the structure of the research teams differs tremendously from one country to another. Sometimes, large teams only dedicate a very small percentage of activities to TRIZ, whereas others invest a large proportion of their activities in this area. The ratio between the number of doctoral students present in the teams and those whose thesis subject integrates TRIZ is worth noting. The graph indicates that despite of a low percentage of research activities devoted to TRIZ, doctoral students have a broader link with these activities. We can therefore conclude that a TRIZ-related form of evolution is directed towards beneficial usages during exploratory work associated with scientific themes. This evolution is all the more convincing when considering the use of TRIZ in scientific circles and seems to be confirmed by an ever increasing number of contributions, articles and special editions dedicated to TRIZ over the last decade in renowned reviews and special sessions devoted to TRIZ in well-known scientific conferences. The high point of all this is linked to the fact that over the past two years, not only have contributions associated with TRIZ become more broadly accepted in acknowledged scientific circles, but they have also won awards in these very communities, thereby proving that TRIZ is accepted as a serious theme for research.

Section linked with academic circles: education

After questions on the make-up of research teams and their involvement in TRIZ, a set of questions attempted to pinpoint the teaching levels and the volume of hours devoted to teaching TRIZ in educational establishments.

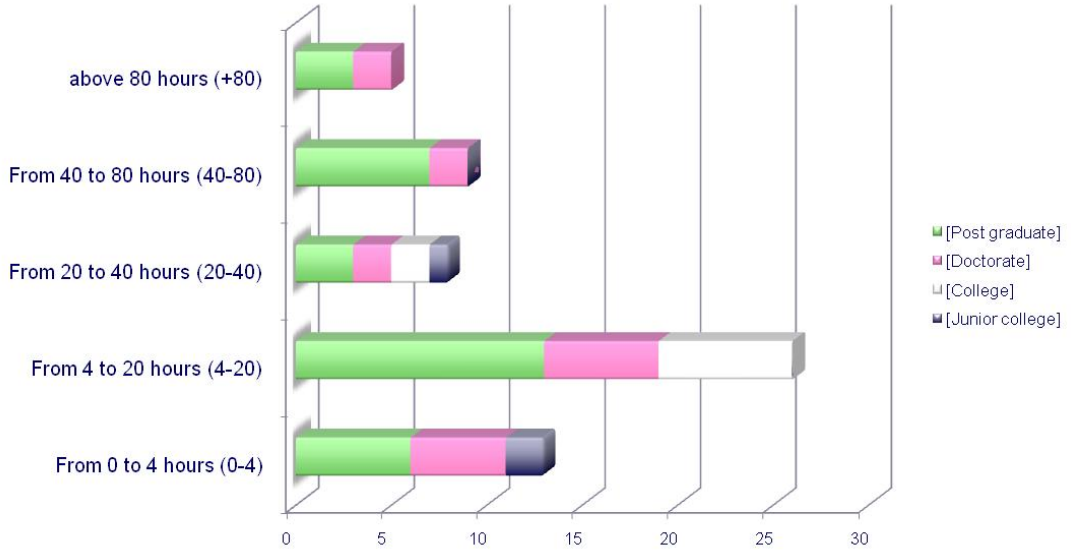

Figure 12: Dominant teaching levels where TRIZ is taught

Figure 12 illustrates that it is mainly postgraduate courses that have integrated TRIZ into the teaching syllabus. While it is true that undergraduate engineering courses contain a volume of hours enabling students to discover what TRIZ encompasses, they are hardly sufficient for students to assimilate all the content and even less to be able to claim they have acquired skills by the end of the course. However, we can also interpret this division as a sign that teaching at undergraduate level requires a tried and tested syllabus as opposed to postgraduate and post-diploma courses where the course content is often left to the discretion of each school. The problem here (which will be confirmed in other analyses further on in this article) would therefore seem to be is an absence of structure and acceptance concerning the fundamentals of teaching TRIZ. If the universities in developed countries worked together to build a teaching syllabus for TRIZ, at different levels, going beyond individual initiatives or initiatives limited to the circle of just one school of thought, it would be far easier for TRIZ to spread through university environments and secondary schools.

Industrial section

Our first observation: it would seem that the respondents, virtually all representatives of large industrial groups, do not wish the name of their enterprise to be quoted. If we take the group of all industrial respondents, the figure stands at 54%, but if we examine the category of "large groups", this figure rises to 85%. We see here a potential desire to cover up the existence of experiments linked with TRIZ, probably because they are still in gestation in these enterprises and that as long as TRIZ is not "accepted" in-house by the hierarchy, it would be better not to quote the enterprise as a reference. We can however go even further by stating that the image that TRIZ reflects to the outside world is not always positive. Should an enterprise therefore declare that it uses TRIZ, it could be associating something negative with its image.

Otherwise the enterprise may be waiting for a positive image to emerge before it officially claims to use TRIZ. We could also believe that significant returns on investment that are not open to debate as to the positive role played by TRIZ therein, take a long time to be confirmed in large structures and that once these positive results are acquired, a desire to communicate on this subject will be triggered off within the enterprises.

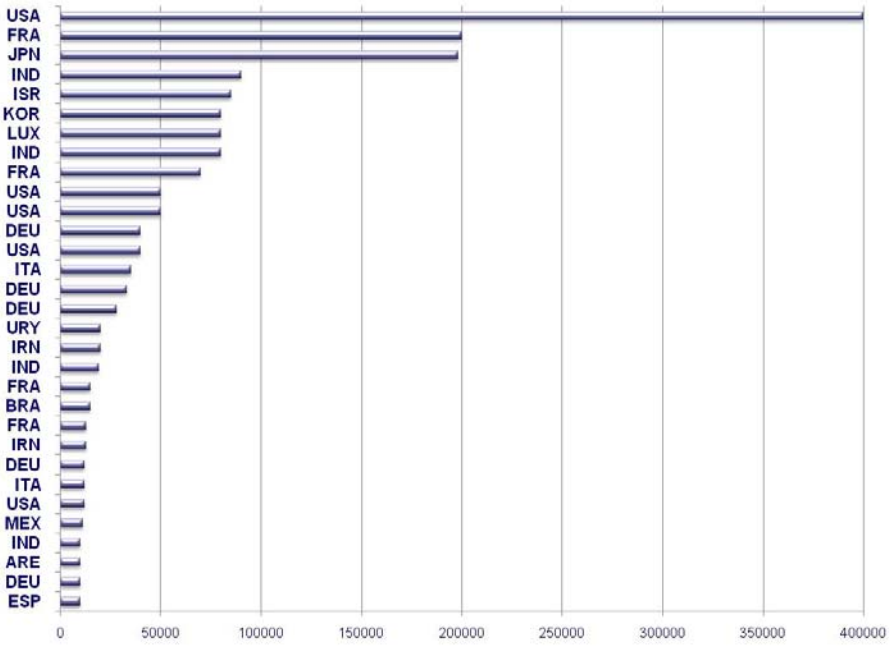

Figure 13: Size of top 30 responding enterprises (Size)

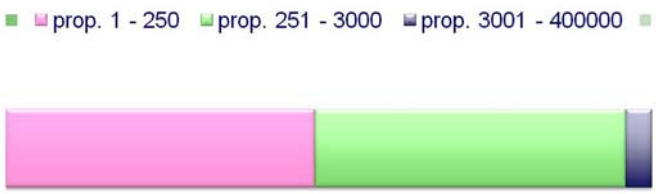

Figure 14: Distribution of responding enterprises

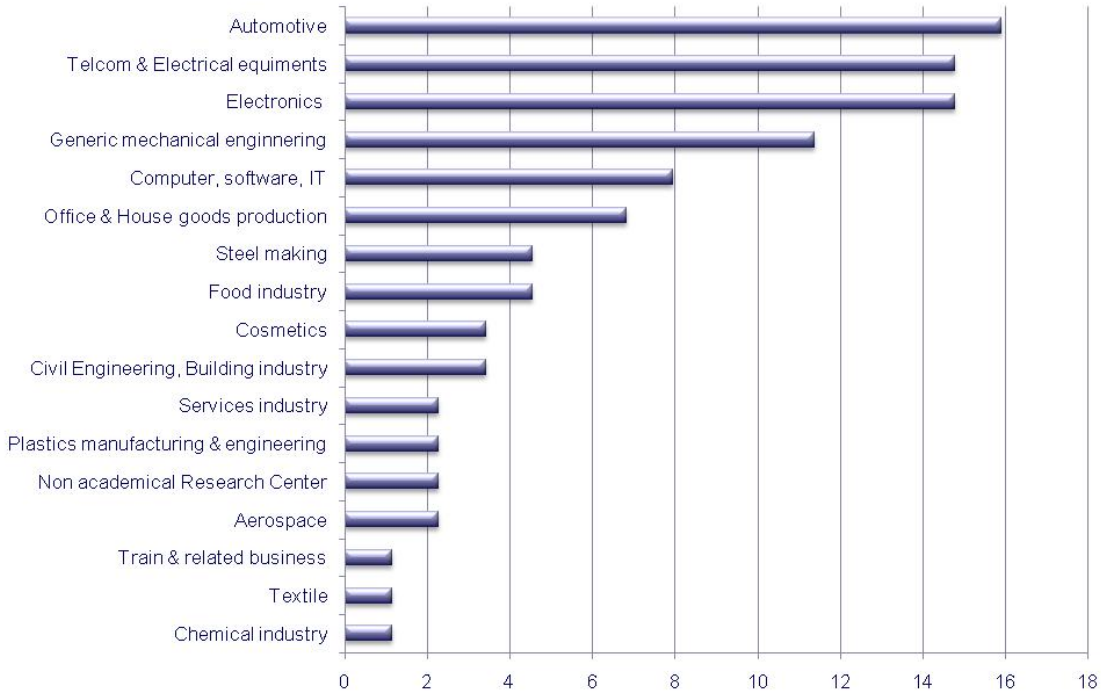

Figure 15: Distribution of industrial sectors (in %)

The distribution of the size of enterprises and their respective field of activities (see figure 14 & 15) is also revealing: based on the principle of quantity, the proportion of replies stemming from large groups is very small. Only 25% of replies concerned groups exceeding 30,000 staff members. Yet if we look at the real landscape of enterprises [6], it is in fact quite the contrary, since there are much more small enterprises than large groups. We are therefore dealing with a very high percentage of large groups here. We can therefore conclude that TRIZ has penetrated large industrial groups, but remains marginal, and even non-existent, in small enterprises. On the other hand, if we compare the proportion of people devoted to TRIZ with to this figure, it remains very low indeed with only 0.02% of staff working in the industrial enterprises polled being involved in TRIZ. We can therefore rapidly conclude that despite being present in highly industrialised sectors for the past 20 years, TRIZ remains marginal in enterprises, and the people officially devoted to exploring it within the companies are still considered as pioneers, or even exceptions, when they work as a team. The prize (for enterprises) goes to Korean, American and German companies which have quoted the number of personnel using TRIZ in-house as ranging from 50 to 600 people.

Let us now move on to competencies. Figure 17 shows that in large groups, all the expertise required is often provided in-house. For medium-sized groups, external expertise is often called upon. It should be noted that for large groups, partnerships with universities are also a source of acquiring expertise. Finally, we included an open-

ended question to qualify any other source of competence and it is undeniably "customers" or relations with "subcontractors" which come out on top.

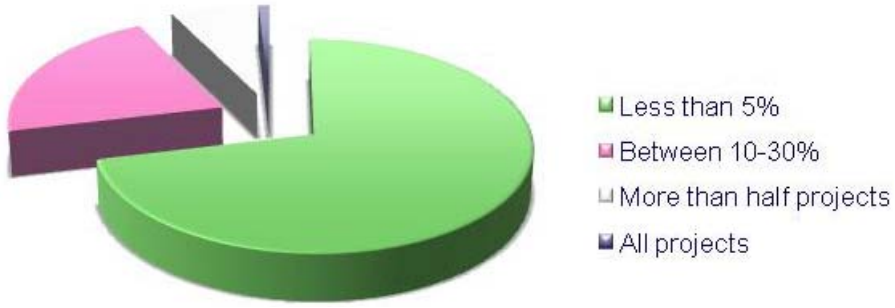

Figure 16: Distribution of TRIZ related activities (out of 100%)

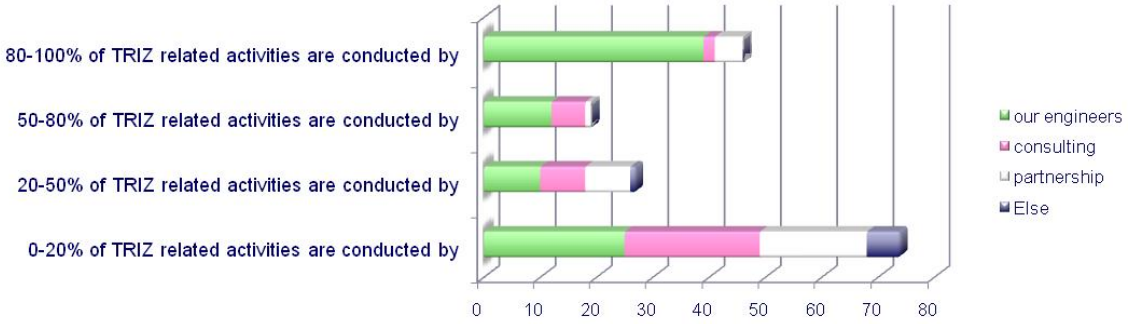

Figure 17: Distribution of internal/external competencies in enterprises

As to the distribution of competencies by level, figure 18 indicates that it is firstly the basic levels of competence which can be found in the enterprises, then some (in particular the largest) also claimed competencies on a medium or advanced level. Expertise at the highest level is only rarely present in industrial enterprises and when it is, it is limited to a few large industrial groups which have integrated teams exceeding the critical size of 10 people.

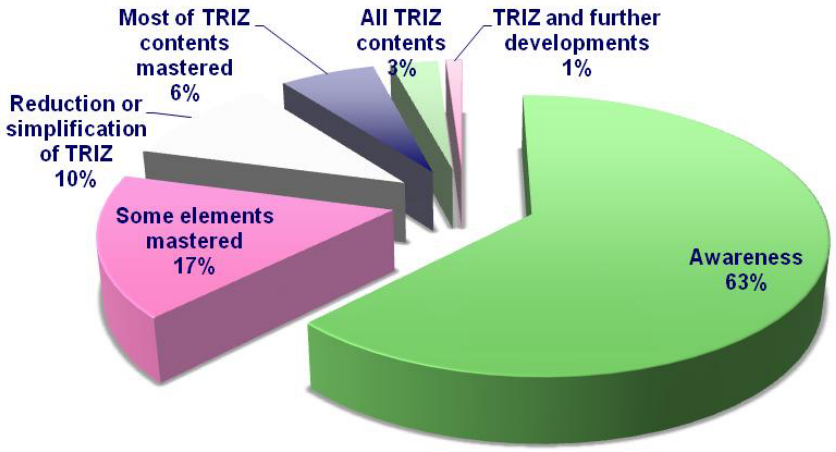

Figure 18: Distribution of level of expertise in organizations (mean)

Finally, in terms of usages, one question was put to everyone: " in addition to the tools and techniques traditionally stemming from TRIZ, do you use what could be qualified as an advanced development of TRIZ?" - in other words a technique, tool or derived theory that does not appear in the classic works describing TRIZ, but results from a new development based on fresh research. Replies to this open question were given in 5% of cases. We see here a latent need for new developments because current knowledge of TRIZ is not enough to meet the expectations of the users. The users sometimes find what they are looking for in the scientific and methodological work of researchers and consultants working on the subject of TRIZ, but at times, they also have to modify what exists so that it is better adapted to the specific requirements of a given company (simplification, rapidity of execution, correlation with the techniques already set up etc.). Figure 19 provides a summary of what are called "new developments" by industrial users answering the questionnaire.

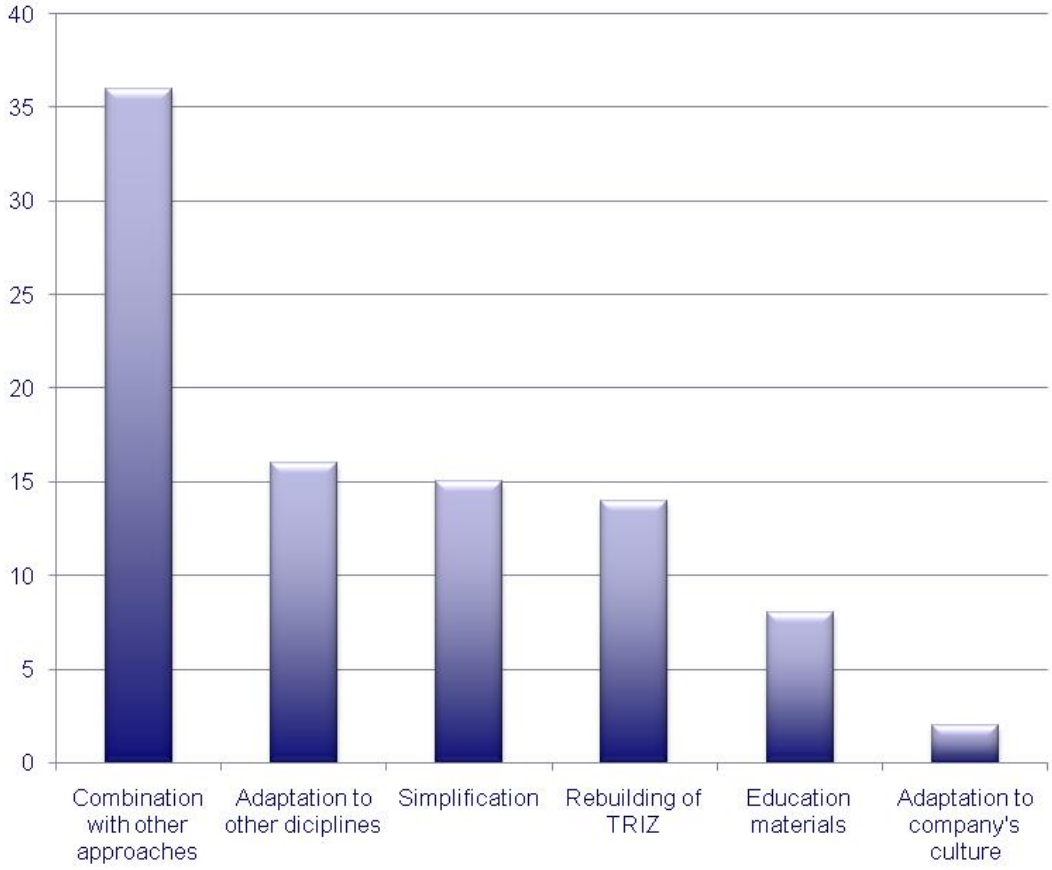

Figure 19: Clustered answers claimed as "new developpment" of TRIZ

Section specific to consulting and expertise

Consultancy firms claiming to use the content of TRIZ made up the largest proportion of replies received. Standing at 39%, they represent the densest population replying to the questionnaire. However, studies have shown that for 300 industrial entities, just one consultancy firm is identified [7]. The reply rate for TRIZ is therefore excessively high when we consider these figures. In our opinion, there are several reasons for this. Firstly, as TRIZ is surrounded by attractive promises for serving industry, it has quite naturally drawn the attention of consultancy firms. Just like quality tools and techniques, the support of consultancy to back up the needs of industries seems to be logical and necessary. In addition to this, TRIZ has an undeniable advantage in its lack of axiomisation. Within this apparent ambiguity, the need to find benchmarks was soon felt at the very time requests for consultancy concerning creativity sessions and setting up quality plans were observed. Among the data already analysed in the previous paragraphs, we note a much higher percentage of permission to reveal the name of consultancy firms and the names of their companies as compared to the industrial sector. There is also a much higher ratio of people dedicated to TRIZ in relation to the total number of people working for the enterprise.

A crucial question was posed to the consultancy firms polled: "What percentage of activity does TRIZ represent for you?". The replies give figure 20.

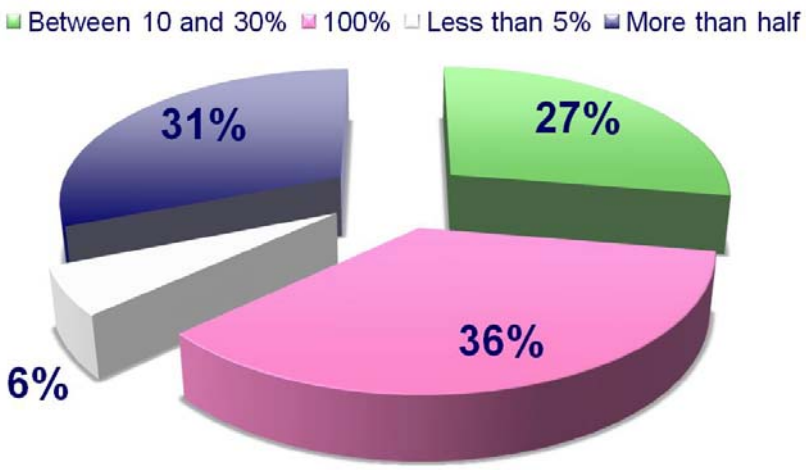

Figure 20: Pie chart of TRIZ related activities for consultancy firms

For consultancy, we can conclude that the dominant choice is that when interest is shown in conducting TRIZ activities, no concessions must be made. Two distinct populations therefore arise from this questionnaire: a population of consultants who are trying out TRIZ with little corporate investment, or the reverse. In this reverse tendency (the majority of replies received), it is the entire company which is focusing its activities on TRIZ so that the image of the company does not suffer from any ambiguity as to its strategy.

Finally, we note that in this category, replies were virtually systematic as to the question previously quoted on the "new developments" in TRIZ. It seems obvious that consultancy environments have developed "around" or "make use of supplements to" […TRIZ] in order to better structure their consultancy activity and examine how it could be used effectively in a consultant/enterprise relationship. This constitutes a sure indicator of the lack of simplified procedural transpositions regarding TRIZ.

Let us now come back to the questions put to everyone in the last chapter and in particular, two categories: liabilities and future intentions.

Liabilities in terms of results associated with TRIZ

Figures 21 & 22 summarises the results of each of the questions asked for which the multiple-choice can be summed up as "yes", "no" or "don't know yet". In some cases, additional information was requested.

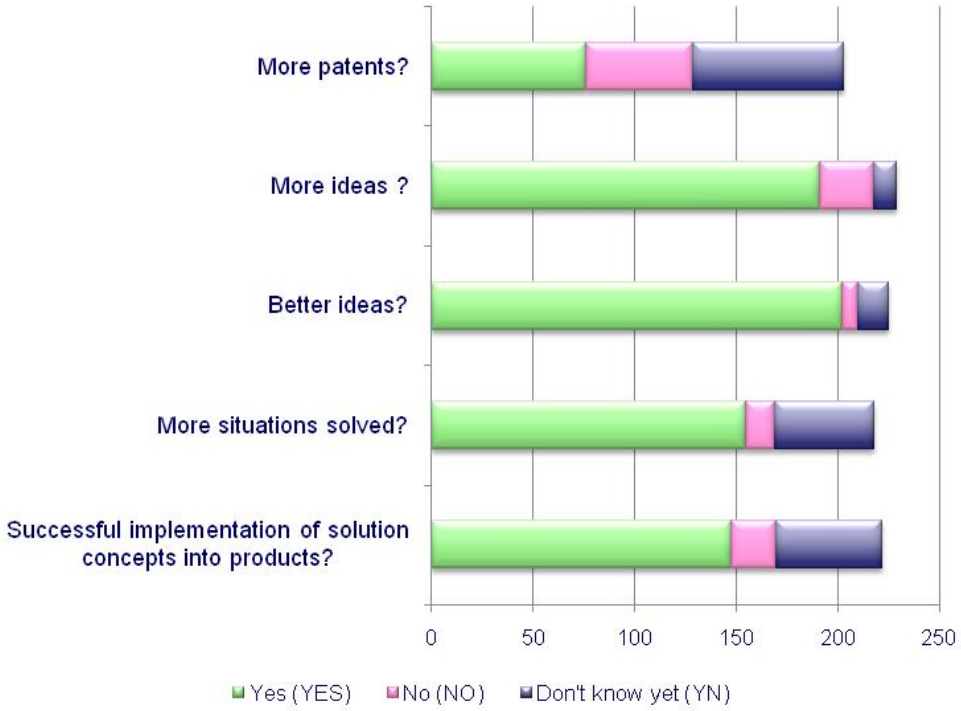

Figure 21: Distribution of aknowledged results in relation with TRIZ use

We clearly observed in figure 21 that the respondents are evidently claiming not just an increase in the quantity of ideas, but also the quality of these ideas. TRIZ is therefore qualified as being responsible for this progress in terms of the creative aptitudes of organisations. Secondly, situations that have been solved are also underlined. TRIZ is also identified as being efficient in terms of problem solving, independently of the level of inventiveness of the concepts it leads to. Finally, we shall reflect on the patents for which TRIZ can be claimed as being the source. Opinions differ more here and while a large number of replies claimed that TRIZ was responsible for more patents being filed, an even higher number stated that it was not yet possible to answer this question. It therefore remains unanswered pending results. We see here a sign that many years must pass before we can gauge the contribution of TRIZ within an organisation. And yet if we add the number of organisations waiting for the results that TRIZ has contributed, to those certifying that these results are salient, we obtain a dominant factor in the replies. The conclusion for this section of the questionnaire is that TRIZ is acknowledged as being at the source of a greater number of better constructed inventive concepts. The fact that this generates more situations solved is no doubt the basis for an increase in the number of patents filed.

Prospects for the organisations interviewed in relation to TRIZ

In this section of chapter 5, we attempted to perceive the future intentions of organisations in relation to TRIZ. With regard to education, no doubt persists. Figure 22 shows us that over 95% of respondents claim that they wish to pursue increasing their

competence on the subject. The same is true concerning a determination to organise internal use of TRIZ (85%). We then come to a second group of replies regarding the desire to conduct research on TRIZ, together with case studies, in order to continue the persuasion process in-house. Research could be directed to personalising the features of TRIZ, i.e. customisation of the theory to specific needs. As to calling on additional in-house or outsourced competences, the replies are more mixed. It would therefore seem that organisations prefer to stabilise expert knowledge in people who are already present (either in-house or outsourced) rather than increasing their number. We see here a possible stagnation of the consulting market, especially taking into account the high percentage of respondents stemming from this type of organisation.

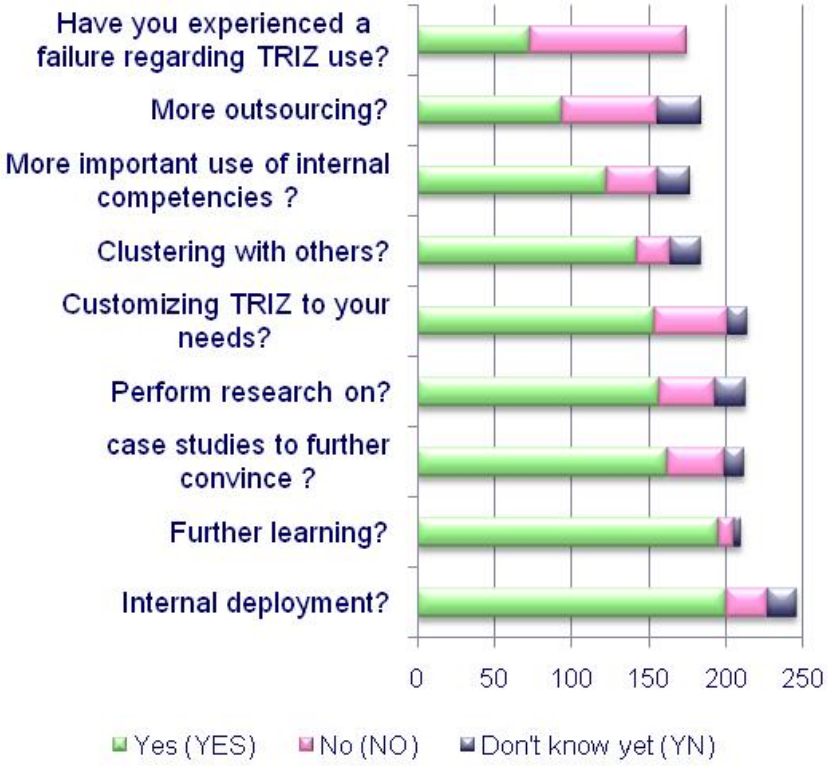

Figure 22: Future intentions in relation with TRIZ

Finally, one of the questions focused on failures resulting from experiments with TRIZ. The percentage of respondents admitting their failures is astonishingly high (nearly 45% of failures declared). These witness accounts demonstrate that TRIZ does not systematically lead to success and that there are probably reasons for this. It therefore seemed logical for us to push further by asking the respondents to give explicit reasons for these failures. The replies are too numerous for them all to feature in this article,

but to give a summary of the trend of the data received, we have isolated in figure 23 the general meaning of similar sentences that were often repeated.

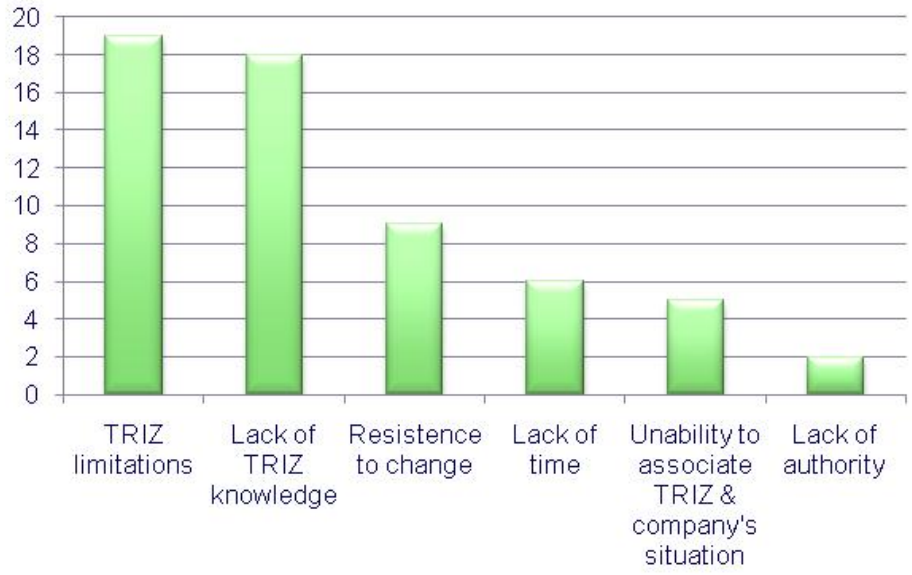

Figure 23: Distribution of TRIZ failures reasons

The most quoted category is entitled "The limits of TRIZ". 19 respondents stated the fact that when TRIZ was used, it did not provide satisfaction, whether this was through a lack of relevant or feasible results or because TRIZ did not seem appropriate in relation to the industrial domain of application. The second category, quoted 18 times, puts the blame for the failure on the lack of knowledge associated with TRIZ. The project leaders, experts and engineers involved in the studies did not have sufficient knowledge of the techniques to profit fully from TRIZ. Ranking third, the next category received 9 replies and remarked on resistance to change within the company and among the stakeholders. To a lesser extent, but with 6 replies nonetheless, we find lack of time. Finally, the last two categories with respectively 5 and 2 replies, comment on a lack of appropriateness between what TRIZ offers and the way in which the company is organised and the level of authority (too low) of the TRIZ expert when failure is observed.

As a conclusion, this part of the questionnaire demonstrates that TRIZ, in its current form, seems to have reached its limits. The blame is particularly placed on difficulties encountered when putting it into practice (through lack of competence or time), as is the fact that it does not seem to be able to address certain problems (only designed to deal with a certain type of problem).

Discussion

At the end of this study, it would appear that organisations (and through them, individuals) are as yet very little affected by TRIZ. Even today, a large gap subsists

between individual perceptions, what each person thinks they understand by TRIZ, and the reality of what can be observed in the field. Users of this theory and its methodological derivatives seem to expect TRIZ to bring them a solution, to cast a fresh light in the limbo of their difficulties, probably because of their experience and their own needs at the time. Yet the history of the theory and its painstaking journey between its beginnings and its acceptance by society is full of pitfalls. It must necessarily be backed by a methodological frame so that it can be applied by a large number of people [8] and so that returns from these applications can provide a unique contribution attributable to TRIZ alone. TRIZ is not at this stage yet, because its bases are still under discussion and its methodological frames and tools are already too numerous even though, as a theory, it has yet to achieve unanimous acclaim. In the literature, including in scientific literature, TRIZ is more often termed as a method than a theory.

Sometimes the words used to describe TRIZ, or rather TRIZ communities, are harsh. However beyond TRIZ itself, its very first, pioneering defenders are often in the firing line. The few proponents who have disseminated TRIZ in highly industrial countries very quickly fashioned a certain image. The image which is sent back to us by the respondents is that of overtired protectionism which is handicapping the evolution of the theory.

To uphold our observations, the last question in this survey was open and invited the respondents to confide in us their feelings on what is lacking in the TRIZ world for more widespread and better use. Half the respondents filled in this question, i.e. nearly 200 replies. Again the data here is too numerous to be listed. However, 5 categories of answers can be distinguished (figure 24). This distinction was made when there were more than “at least” 25 replies containing the same meaning (or sufficiently similar meanings).

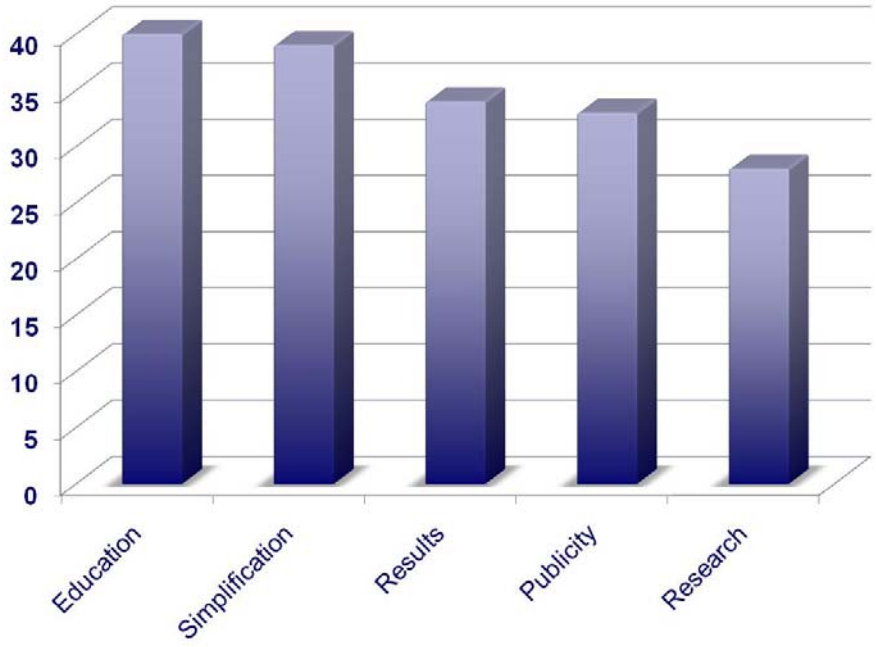

Figure 24: Distribution of answers to the question: "What is lacking in the TRIZ world…"

The first category "Education": in the replies given in this category, we find a majority of requests to set up courses, teach and make teachings of TRIZ universal at all levels. The post-engineering level is nonetheless slightly put to the fore and the comments are more particularly addressed to universities which are requested to build teaching syllabuses with a minimum common basis shared worldwide.

The second category "Simplification": ranked immediately after, it is requested that TRIZ should be revised with a move towards simplification. By simplification, we understand overcoming the obvious and off-putting complexity of TRIZ, but also the time required to assimilate it. Indeed, even though numerous opinions are voiced upholding the fact that time has to be dedicated to learning TRIZ, current social restrictions means that time dedicated to learning is a rare commodity. And even though the respondents agree that TRIZ deserves great commitment, the time currently required (around 100 theoretical and practical hours and long years of experience to gain expertise) seems out of reach for many. We could here speak of the known attempts to simplify TRIZ (sometimes quoted by the respondents) such as SIT, ASIT or USIT. These initiatives are known and even if each of these approaches today follows its own evolutionary path, it would seem that respondents do not find in them a palliative to the lack of techniques stemming from TRIZ.

The third category "sharing results": it is well known that TRIZ practices are shrouded in secrecy. Addressing mainly innovation in enterprises, successes are far less apparent than failures of its application. This reflex is deeply rooted in our companies and it would appear to be far more urgent for an enterprise to work on the development of

prototypes, filing patents and experimenting, than to publicly talk about their results outside the enterprise. Sometimes a few rare glimpses are released when a conference is held, but very few enterprises feel ready to give witness accounts of successes stemming from TRIZ. The rare accounts are therefore systematically taken up in online documents on the Web or other writings and rapidly weary those who need to be taken by surprise to believe in it. On the other hand, salient returns on investment alone could prove the efficiency of TRIZ, but everyone knows that many years must pass for such results to emerge in an obvious manner. The paradox of this request resides therefore in the fact that many respondents call for a collection of examples compiling the successes of TRIZ, while themselves refusing to be featured therein, even when perfectly good examples are legion in their enterprise.

The fourth category "Communication": along the same line of accounts on the need to increase communication about TRIZ, 39 respondents called for more marketing focused on TRIZ. Indeed, while TRIZ has been exploited by researchers, teachers and industrial users up until now, it has rarely been the subject of a large-scale marketing action conducted by professionals in the field of communication. And yet there are always obstacles when people who only have a little time to dedicate to understanding TRIZ (for example managers) receive a complicated and confusing message on this subject. If today a mini "buzz" about TRIZ has spread to a handful of enthusiasts, we are still far from a real, far-reaching buzz on a worldwide scale affecting all categories of people and all socio-professional levels.

The fifth category "Research": with 28 converging replies, respondents also criticise research activities focused on TRIZ. They find that too few research establishments are investigating the field of this theory of invention, even though it is well known that a meaningful methodological framework cannot occur without a solid theoretical and scientific foundation. Furthermore, if we want to see this theory develop and expanded through a range of methods, or even be a subject of contention so that it can mutate and then evolve, then it is well and truly an emulation centred on research laboratories that we need, creating knew knowledge beyond TRIZ. Some laboratories have branched out on this subject, but the teams internal to these laboratories do not seem to have reached their critical size in most cases. And, in all cases, the scale of research on the subject of TRIZ cannot be compared to other scientific orientations.

Finally, we wanted to summarise some comments in the table 2 pointing a finger at TRIZ communities (some of them have been translated into English).

Other comments for TRIZ communities	Count
Stop being so parochial	1
Stop using the word TRIZ	1
Less manifestations of hyper-developed egos and arrogance	1
More easier cases and less stubborn attitudes of my way of TRIZ vs Your way of TRIZ	1
More feet on the ground	1
Get rid of the jingoism that is ruining 6 sigma deployment in SMEs.	1
A vision and a leader as Jack Welch for 6 sigma in GE	1
A LEADERSHIP !	1
Unity	1
Use TRIZ to elimination of poverty	1
I wish I knew	1

Table 2: Other comments for TRIZ communities

They represent nearly 15% of replies and their content is sometimes revealing. One further remark that we would like to make following these open-ended answers is that out of 319 respondents, there was just one single request for certification. This low percentage does not incite us to see certification as a crucial direction for the evolution of TRIZ.

Conclusion

It is a well-known fact that Industry's future stakes are dependent on a robust and dynamic teaching foundation [9]. The academic world teaches the theoretical bases of new knowledge linked with the development of industrial needs, whereas the consultancy world transposes some of this knowledge, still in the form of theory, into pragmatic methods and tools which enable industry to acquire new, practical competencies. TRIZ and its theoretical postulates, together with its techniques, methods, tools and knowledge bases, are no exception to this rule. The respondents of the questionnaire mostly identified the theoretical gaps in TRIZ and advocated legitimate evolutions towards greater legibility of how the knowledge to be acquired is sectioned in order to increase competencies in a structured, rapid and efficient manner. With this in mind, several people recommended that the TRIZ communities should rebuild their fundamental bases moving towards greater simplicity, but without detracting from the precepts which make TRIZ a unique theory and which, in its current versions already contributes so much to those who accept to devote time to learning the theory and putting it into practice.

Secondly, sharing is greatly upheld since emulation could stem from a base of successful cases giving TRIZ more notoriety than it enjoys at present. The idea that successful studies will attract other successful studies and that a base of case studies sanctioned by praiseworthy results could provide arguments when confronted with the task of persuasion, is well founded [10]. But everyone knows that the fruit of other people's work cannot systematically be applied to oneself. Such an argument cannot stand up for long if an item specific to one enterprise casts doubt as to the transposability of results.

Finally, the notoriety of TRIZ is currently side-stepped by the illusion created by the enthusiasm of those all working towards making it more widespread and supporting its evolution. While we are pleased with the few press articles that boast the merits of TRIZ published here and there in reviews with a broad readership, the figures which can be put forward via this questionnaire are revealing: only 0.02% of engineers in the enterprises replying to the questionnaire use or have used TRIZ, where as 13% of this population know and use the tools and techniques of quality based on the notion of value. This represents 650 times more. The road towards notoriety is therefore still very long and a good third of respondents called for work on popularising TRIZ for a broader diffusion, conducted by professionals from the field of communication, especially in the frame of fostering awareness of its existence among managers and the potential role it could play in the necessary industrial changes that are in the offing.

To end, we hope that this article will shed light on the subject for communities working on the evolution of TRIZ. The time invested by all the people who participated in this project is considerable and, through this project, we hope to have contributed to the future directions of these communities' projects.

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- The translators who worked to transcribe the questionnaire into the 8 languages (see table 4);
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Table 3: Coordinating members per country

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Table 4: Translators and languages

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