

Creative teamwork in quick and long term project development, 24 hours of innovation

Luz-Maria Jiménez-Narvaez
ÉTS, École de Technologie Supérieure
Montréal, Québec, Canada H3C 1K3

and

Simon Desrosiers
ÉTS, École de Technologie Supérieure
Montréal, Québec, Canada H3C 1K3

and

Mickaël Gardoni
INSA de Strasbourg,
Strasbourg, France, 67000
/
ÉTS, École de Technologie Supérieure
Montréal, Québec, Canada H3C 1K3

ABSTRACT

The charette is “an intensive, concentrated and deadline oriented group confrontation and discussion technique applied to identify, analyze, evaluate and solve educational, organizational and community problems and needs” [3]. In this paper, we are interested in comparing the charrette with the long project development, in the analysis of creative activities. From the charrette, several issues are questioned, such as the importance of the group maturity and the skills of the participants. About industrial project development inside a competitive world, there are some questions about the Quick Projects Development QPD and also for the long periods of developing. We consider that our research could clarify four discussion topics regarding creative teamwork in charrette in the particular context of 24h charrette duration: a) team building and the idea development into the 24h, b) an analysis of the issues presented in the innovative projects and the response of the team, as well as, c) the use of time in work sessions and d) the role of the leader in the team creative performance. These answers are important for the planning of teamwork in the PD activities of technological projects. This comparative study was carried out within the context of the Fourth Edition of the 24 Hours (24H) of Innovation international competition and a project of 3 months.

Keywords - Quick projects development, Long-term project development, creative work, collaboration in design, designing for innovation

1 INTRODUCTION

The 24 Hours of Innovation (24H) is an international competition created by the École Supérieure des Technologies Industrielles Avancées (ESTIA, France) with the purpose of developing innovative solutions. The competition is set in the time frame of 24 consecutive hours and crafted to address students from a variety of disciplines, as well as universities. This year, the Fourth edition took place in Bidart, France, October 22 and 23 2010. The teams were challenged to come

up with an innovative solution to a problem presented at the beginning of the event¹, and then were assessed by the academics and manufacturers. Approximately 250 students attended the competition divided into 27 teams made of 1 to 11 members. This year, 34 projects were proposed to the teams. Each team freely selected the topic of its work, in accordance with its members' experience, knowledge or project interest.

24H is a student competition that involves organizational team strategies and creative collaboration. The organization of teamwork during the execution of short term innovative projects arises numerous questions [10], especially:

1. What is the influence of the interdisciplinary grouping of teams? Is there some special influence of the team composition by gender, or by field of study (industrial, construction, physical, informatics, ergonomics, computer, consulting, management, and logistics)?
2. How to assess the demands posed on the teams in function of their experience?
3. How are the teams influenced by the prior knowledge of the members?
4. Is there any importance of the number of ideas produced and the time taken of the selection of ideas?
5. Does the leader have a role in the creative teamwork performance?

Our research interest of the team creative performance in the QPD is driven by the possibilities that the answers could impact the industrial projects development. As we know, the businesses impose strict time constraints to its product development teams in order to reduce costs of research and development (R&D). For this reason, the creative stage of design definition is crucial for the overall performances of the product. The initial ideas presented by the teams in charge of conceptualizing the product, generate a “path dependency” through the entire project development, and also create a “snowball” effect in the following stages of production: changes made during the first stage of the project are less

¹ For more details, please see:
<http://www.24h.estia.fr/index.php?lang=en>

costly to bring about than the changes made during the final stages of production [5].

One aspect of the QPD is the question about if this “creative burst of energy that builds momentum for a project and sets it on a course to meet project goals” [12] should be effective in terms of creativity thinking or creativity performance. Lindsey et al, [12] also mentioned that the charrette could “transform a project from a static, complex problem to a successful, buildable plan” (Ibid). Usually, it is an intensely focused, multiday session that uses a collaborative approach to create realistic and achievable designs that work.

On the other hand, company teams are formed within an interdisciplinary context. In other words, teams are not created according to the employees creativity, but instead, according to their professional competence (domain-skills) [4]; this way, comprising different levels of experience. Also, expert members could work with the novice members. Hoegl and Parboteeah [8] claim that experience and shared abilities allow for a team to be more efficient in completing tasks, but not necessarily in the effectiveness nor quality of their creative solutions [1].

Other important aspect of the charrette activity is the benefits to facilitate the “interaction and feedback mechanism between industry respondents and academia” [7 p. 67]. Also, the charrette is used by “researchers to gather data relatively quickly, collect valuable input from experienced practitioners, make excellent industry contacts, and gain insights with several collection strategies” (Ibid, p. 75)

In the scope of work carried out by the 27 teams, we analyzed four variables linked to the activities of creative teamwork in QPD and the comparison of the Long-term Project Development (LPD): a) the interdisciplinary grouping of teams, b) the assessment of the task demand (projects proposal) posed on the teams, c) the influence of experience and prior knowledge, on the number of ideas produced and the selection of ideas into the time assigned and, d) the composition of team in relation with the leader influence.

2 METHODOLOGICAL PLAN FOR THE STUDY OF CREATIVE ACTIVITIES IN 24H

After the implementation of the experimental protocol during the Montreal Edition of the 24H, our research group decided to conduct a comparative study between the creative teams that attended the Fourth Edition of Bidart and the Canadian team T27[11]. Contrasting our initial experimental protocol elaborated for monitoring the quick project development, we elaborated a protocol for a long period. We decided to carry out an investigation in accordance with the time as a variable and to add another variable: the analysis of the influence of the leader in the performance of the group. The hypothesis was that in QPD, the creative teamwork performance is not affected by reduced time period of work.

2.1 Subjects

After an invitation was sent out by the organizing committee, almost 200 students registered and attended the local competition and 42 students worked from remote locations through videoconference from Grenoble (France), Bath, Wolverhampton (UK), and Montréal (Canada)². During the 24H, the constitution of groups is free. Often, students accustomed to work together, gather in the same team.. Other participants first picked the topic or one specific project owner and then constituted the team randomly with other members according to their order of registration. In Table 1, we get a glimpse of how the teams were formed: number, field of work

and institution. Following the jury's assessment, the first 10 teams were ranked according to their position at the end of the competition. The teams with an outstanding creative performance were placed from T1 to T12 and the teams without a mention from T13 to T27. And in Table 2, we show the composition of the T26 during the 24H and the longer period. The participants of T27 were undergrad students from ÉTS, three enrolled in electrical engineering and one in IT engineering. The shaded portion represents the students composing T27.

2.2 Task

a. Charrette 24H

The competition begins by a 60 minute meeting made for groups to prepare their constitution, and to choose their topic. Demands and constraints of the competition are first presented. Then, alternatives projects – and their issues - were presented to the students during a 20 minute PowerPoint presentation. Thirty four projects were proposed. The remaining 23 hours are then freely used by the groups to plan a strategic solution or outline a process for achieving it. At the end of the 24 hours, the teams have 3 minutes to present their solution.

b. Long period activity 3 months

After the competition, the enterprise requested the participation of team T27 to develop in details ideas and solutions exposed during the competition. T27 at the beginning was composed by six participants, and then by 4 participants. The activities of this team were developed at ÉTS during 3 months.

2.3 Procedure

We decided to study the variation in quantity of ideas produced in the 24H by the first prized team T1 and by T27 in their participation during the long period of time. We also asked them about the composition of the team: a) the team and their personal creative characteristics, in particular the leader's intervention, as well as, b) the team confidence –how was the work dynamics. These responses were compared between the average of the first prize team composed and by the performance of T27 in the long-term.

We also ranked the team performance according to the general classification – the main “output” obtained for each winning team (10 teams) in function of judges decision (Committee of decision of the contest). We have to highlight that the creativity assessment is a contextual and social assessment [2], for this reason, we used at this study the same classification assigned for the final judge results. They classified the teams at the end of the competition, according to the teams' presentation.

Table 1. Team composition by number of participants, time of knowing each others, discipline and school

Team	n	Domain	School	Time of grouping	Award
T1	10	Mechanical, Electronics, Software, CAD	ESTIA (9), ECE Paris (1) Fr	+2 years	1st Prize
T2	10	Mechanical, Software, Design	ESTIA (8), Ec. Boole/Cachan (1), Nursing (1) Fr	+2 years	2 nd Prize
T3	10	Engineering, Business	Mondragon Univ. (8) Sp , ESTIA Fr (2)	+2 years	3 rd Prize
T4	10	Enterprises-Leadership	Jyväskylä Univ Fi (8) Mondragon Univ Sp (2),	-1 year	Best Breakthrough Award
T5	10	Enterprises-Leadership-Innovation	Mondragon Univ. Sp (10)	-1 year	Best Marketing Award
T6	10	Engineering 1 st year & 2 nd year Mechanical, Electronics, Software, CAD	ESTIA Fr (10)	+2 years	Best Virtual Animation Award

² For more information about 24H Bidart you could see: Jimenez et al (2011)

T7	10	Communication, Materials, Engineering	ESTIA (5), Biology (1), Ec. Mines (4) Fr	+2 years	Best Prototype Award
T8	6	Engineering 1 st year	ESTIA Fr (6)	-1 year	Best Environment Award
T9	10	Engineering, Sport	ESTIA (5), IFMA (4), Sport (1) Fr	-1 year	Best Invention Award
T10	10	Engineering	Unemployed Engineer Fr	Alone	Award of the perseverance
T11	5 (5)	no data available (videoconference)	Wolverhampton Univ. UK		Best Design Award
T12	10	Engineering, Anatomy	ESTIA (2), Ec. Mines (6), Sport (2), Fr	-1 year	Best Video Award
T13	10	Mechanical, Biology	UTC (5), ESTIA (4), UTBM (1)	-1 year	
T14	10	Economics, Finance, Engineering	ESTIA (2), Mondragon Univ. (8)	-1 year	
T15	8	Electronics, Mechanical, Ergonomics	ESTIA (3), ENIT (2) UDS (3) Fr	-1 year	
T16	7	Engineering 1 st year	ESTIA (7) Fr	-1 year	
T17	10 (5)	Mechanical, Design (videoconference)	EILCO (5) Fr , Bath Univ. (5) UK	(5) +2 years	
T18	6	Aeronautics, Ind., Commerce	ESTIA (3), Ec. Mines (1) Consulting (1) Fr Ec. Commerce (1) Sp	0 years	
T19	7	Industrial maintenance	Univ. Paris 8 (7)	+2 years	
T20	3	Inform., Mecc-electr	ESTIA (3)	+2 years	
T21	10	Engineering 1 st year	ESTIA (9), INSA Toulouse (1)	-1 year	
T22	10	Industrial Design	Mondragon Univ. (10), Sp	+2 years	
T23	8	Ind. Design, Architecture, Engineering	Mondragon Univ. (8), Sp	-1 year	
T24	11 (10)	Mec, Indus, eco-design (videoconference)	INPG (11)	-1 year	
T25	10 (9)	Eco-design, Software, Maths (videoconference)	Master GMP (3), INPG (7)	-1 year	
T26	10 (8)	Mec and IT Eng., Law, Political Science, Environment (videoconference)	ÉTS (6), Université de Sherbrooke (2), UQAM (1), UQO (1)	-1 to 2 years	Local Award
T27	5 (4)	Elec, It Engineering	ÉTS (4), Université de Sherbrooke (1)	1-2 years	

Table 2. Composition of T26 and T27

#	Domains	Schools
1	Electrical Engineering	ETS
2	Electrical Engineering	Université de Sherbrooke
3	Electrical Engineering	ETS
4	IT Engineering	ETS
5	Electrical Engineering	ETS
6	Law	Université de Sherbrooke

7	Political Sciences	UQAM
8	Mechanical Engineering	ETS
9	Environment	UQO
10	Innovation Management	ETS

Data was collected using interviews done at three moments of the competition and data on the creative performance of the groups were collected by adapting the experimental plan by Vangundi [14].

Interviews were prepared according to a questionnaire covering the following subjects:

1. Group composition and grouping characteristics
2. Ideas evolution and team previous experience of work
3. Perceived complexity of the problem
4. Performance of the leader

The main questions were:

1. What was the number of ideas before making the selection of the idea?
2. When was the idea selected?
3. When was the idea fully defined and what were the following activities?
4. What was the amount of time the group members had known each other?

What were the needs, resources and difficulties to develop the idea?

3 DATA ANALYSIS

3.1 Time Required for Team Building and Interdisciplinary Fields.

We adapted the VanGundy (VanGundy, 1984) evaluation of creative performance of team. The assessment consists of a questionnaire on how teams were created based on 16 personal characteristics: tolerance to ambiguity, ability to work with complex problems, flexibility of thought, capacity to come up with multiple ideas, research of original ideas, level of control over the project, perseverance, self confidence, risk taking, ability to see a problem from different points of view, extraversion, convergent and divergent thought, intuitive and analytic thought, ability to add details or improve on a proposed idea and interest in aestheticism and the ability for independent thought. VanGundy [14] also suggests teams internal characteristics: 1) same sex, 2) diversity of personality, 3) homogeneousness in creative skills 4) compatibility: when mutual needs are fulfilled 5) ability to work together 6) Vangundy proposed that the required time for team building is two years: less than two years of work experience have a lower score, and 7) group size: made of 3 to 4 members.

We adapted the assessment from VanGundy [14] to an evaluation according to five group characteristics, see Table 3. Each of these characteristic is evaluated by a scoring system from 1 to 5 (1 represents the absence of the characteristic, and 5 its higher presence). A higher score represents strong compatibility in a creative work team and clarity in reporting the complexity of the initial task assigned to them. In Table 3, we can observe the final results achieved by the teams.

The score inter-domain is high when the team was composed by different disciplines or professions. The item grouping time shows that inside the team there are members who know each other for more than 2 years (VanGundy [14] confers more score if the team have certain maturity). The homogenous item refers to the equal manner of discussing in the process of sharing the ideas given by the teammates. A high score means a good homogeneity in the manner of taking a decision by the team.

Table 3. Team characteristics adapted of Vangundy's group creative assessment [14]

Scores	T1-Charrette QPD	T27 - LPD
Inter-domain	3	3
Grouping time	4	2
Homogenous	2	3
Personal compatibility	5	2
Total	14	10

Personal compatibility is a score proposed for the leader to assess his/her perception of the compatibility between the members of his/her team.

3.2 The complexity of the problem perceived by the participants

The perception of the problem's complexity is evaluated through the form "assessing task clarity" [14, p. 138]. This evaluation allows the team members to estimate, amongst other things: the complexity of the problem by reporting their given efforts, their previous experience in the subject matter, the time needed to develop a solution and the number of procedures or operations required to complete the project. Table 4 presents general scores obtained by each team. Moreover, analyzing the VanGundy [14] results in Table 1 indicates the need to emphasize the efforts on the lowest scores in the assessment of complexity of the creative question.

Table 4. Task complexity adapted of Vangundy's assessment [14]

Scores	T1	T27
Domaine K	4	4
Complexity perception	3	3
Subjet-K project	4	3
Flexibility	4	4
Risks	4	2
Total	19	16

To analyze the results, VanGundy [14] proposed that the score of the group's composition form and the assessment of the problem complexity should be summarized. We choose an adapted scoring system from 0 to 20, and the assessment of the project's complexity score from 0 to 30. We observed in Table 3 and Table 4, certain homogeneity in the results of the assessment of the Team's Composition (Table 3), and in the Complexity assessment (Table 4). We are inclined to think that these results are coherent with the mandatory numbers of teams within the competition and their freedom to select their subject of work.

It is to notice that VanGundy [14] mentioned that should pay attention to the lowest score. So, we decided to study the variable of the knowledge of the domain and the subject matter of the project, inside the item of Problem Complexity Assessment, as seen in Table 4.

3.3 Production of ideas (time variable)

3.3.1 Charrette activity 24H Bidart

In Figure 1, we find the results of the number of ideas produced and the time when the idea selected appeared. Figure 2 shows the amount of time spent in group work according to the teams themselves to the idea development process: Ii is the time that the first idea appeared and iD when the team finished the process of idea selection and then begins to work on the presentation.

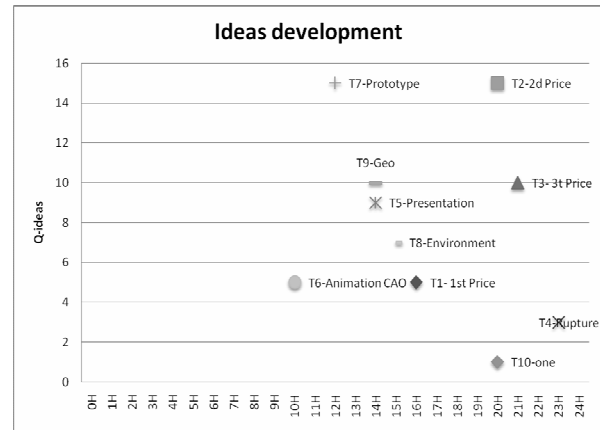


Figure 1. of ideas produced and time of idea selection throughout the competition.

In Figure 2, we placed the total production of ideas (Q-ideas) throughout the 24 hours until the time of the selection of the idea. The teams that came up with a large number of ideas, such as T7, T2, T9 as well as, the teams producing a limited number of ideas, such as T10, T4, T6 or T1 proceeded at a slower rate in reaching their selected idea.

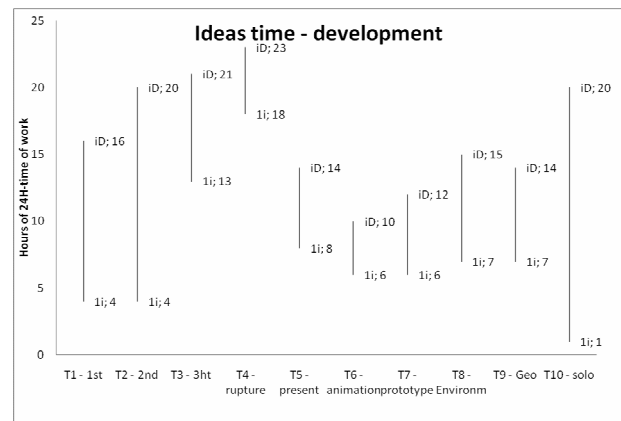


Figure 2. Time of development of the ideas by team.

Nijstad et al. [13] explain that teams can limit their creative flow by becoming attached to an idea too early in the process or by lacking of an idea selection. Another aspect that stands out is the importance given to details or deadlines. Also, the early work impacts the ideas production as seen in Figure 2. The teams that resort to different tools for modelling their ideas, progress much faster in the selection of their idea. We would like to highlight that team T6 and T7 were the most prepared in regards to informational tools. They also developed the most sketches and designs, and asked for help from the organizers to ensure that their selected idea was properly targeted within the criteria of competition.

In the teamwork dynamics, as shown the Figure 2, we could see a different pathway of development between the teams that were awarded by the project T1 to T4, and the teams T5 to T10 which developed some project characteristics: the presentation, the animation or the prototype realisation.

Also seen in Figure 2, the winning teams began creative teamwork quickly. Four hours after the beginning of the contest, T1 and T2 were able to begin their creative work, while the other teams began their work only after at least six hours. In contrast, T1 and T2 had more time for the development of the idea from 16H to 20H. Teams T5, T6, T7, T8, and T9 had an early process of idea development from 10H to 15H; they spent more time in the detailed work of the idea selection. In that way, T5, T6, T7, T8, and T9 spend more time in some aspect of the idea presentation. Team T4, awarded the price “Rupture” had an atypical performance. It had a very low number of ideas (5) and a later process of development and selection. T1 and T2 had a better understanding of the subject matter of their project and applied a strategy of more elaborated ideas and product definition. The strategy of T5, T6 and T7 was centered on the presentation of one idea less matured. In the next section, we will propose an analysis of that kind of teamwork.

The teams with experience on the subject matter of the project such as T1 or T8, produced the lowest number of ideas, as well as T4 or T6 with the least experience. T2 and T7 produced the greater number of ideas. T4 and T7 required the most amount of time to select their final idea as seen in Figure 5.

3.3.2 Long-term Project Development

Following the 24H, the Canadian team, T27, was requested by the company they selected the project from, to continue developing its idea. The team had a period of 3 months to develop a working prototype. Because of several constraints on top of the team and task characteristics, the team shows a different behaviour when generating new ideas. Amongst those constraints, we count 1) the stress factor not being as present as during the 24H, 2) the availability of the members considering that the project was directed alongside of their school academic activities and the fact that the project began a few weeks before the exam period and the Holiday break, as well as 3) the availability of outside resources and equipment.

It is to be mentioned that the team was working on a solution that had been presented during the 24H, and this affected the scope of the project now being to take a concept and build a working prototype. To be able to do so, they required specific knowledge about the existing technologies and the equipment that supports it. Their academic background gave them basic knowledge for the work they had to accomplish, but the members still had to gain more experience to facilitate the work. The team also had to acquire the technologies either through ETS or the company to be able to carry out the development. Figure 4 shows the number of ideas produced throughout the three months. The development is now at week 8.

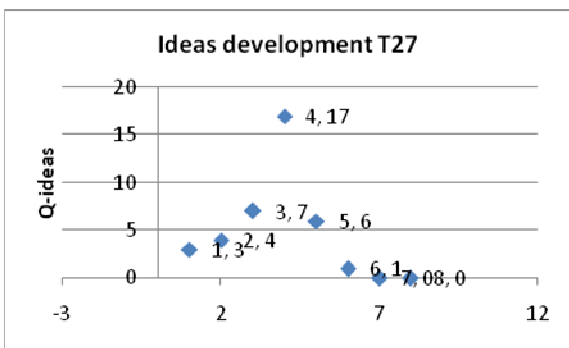


Figure 3. Number of ideas produced throughout the four months

Based on figure 4, we notice that the number of ideas is low during weeks 1 through 3, which represents the exam and the Holiday periods. This decrease is caused by the limited

availability of the members and the personnel from the school and company during that period. The team generate a maximum of ideas at the return to school, week 4. Also, a decrease in idea generation appears as the project deadline approaches resulting from the stabilisation of the project and the arrival of the purchased equipment.

Although T27 members knew each other for 1 or 2 years prior to the 24H, they have never had the opportunity to work on the same project because of their field of study or the year they belong to. During the 24H, they got to know each other better and then choose to continue working together on the “real” project. This situation is another source of change in the idea generation behaviour.

3.4 Leader role in QPD or in LPD

In QPD or charrette, Lindsey et al (2003) [12] explain the role of facilitators. The facilitators are able to “motivate the participants and keep the charrette on track, demonstrate skills in encouraging constructive contribution from all participants and adhering to the agenda to ensure participants and organizers are satisfied with the results” (p.10). Lindsey et al [12] suggest that all the participants commit to “add to the charrette experience through needed expertise, credibility, funding or support” (Idem). In fact, the advantage of the charrette is the identification of potential partners.

We assume that in the creative teamwork, in particular in the larger teams (T1 was composed by 10 participants according with Bidart protocol), the leader had a special role in the team performance. In order to improve the creative potential of the groups [14] “group leaders can exert considerable control in helping groups to attain this potential [...] among the important group condition that a leader could control to some extent are openness to the ideas of others, willingness to take risks, perception of the internal environment as nonthreatening, feeling of freedom and spontaneity, and in general atmosphere of trust” (p. 7).

The leader influences the team dynamics and in our case, he could determine the team idea selection and the team idea development. Also, the leader could influence the team, when he/she manages the knowledge of the team and in the group idea selection or development, the leader could act like: “a proposer, a prescriber, an evaluator or a legislator” (Choulier, 2011, p.83). The data obtained does not let us analyze more deeply these roles, but we can observe that the leader of T1 had a relative high score as seen in Table 5.

Table 5. Leader intervention assessment

Scores	T1	T27
Leader K-sharing	5	3
Leader ideas acceptation	4	4
Leader process control	4	5
Self-esteem	5	3
Total	18	15

4 CONCLUDING REMARKS

The teams' work dynamic is the main subject to QPD and is favourable when the teammates possess the appropriate characteristics, both personal and as a group. Essentially, they must possess creative traits such as: tolerance to ambiguity, perseverance, flexibility of thought, the use of different media or research tools and the creative nourishment of the chosen idea. Moreover, the results are favourable when there is balance between previous experience and a large number of ideas produced in at earlier moment, and awareness and

extended process of the selection of the ideas. This time, we didn't find enough information or data to conclude on the importance of the group maturity (time of the group work together for more than two years), as shown the Table 1, 58% of the awarded teams had more than two years of working together or the inter-domain or inter-disciplinary and it has effected on the team performance.

The range of professions amongst the participants creates an interdisciplinary effect, and we assume that this could have a positive effect on the team's composition and on the assessment of the perceived complexity of the issue. Nevertheless, the multidisciplinary group or the skills diversity did not have a direct influence on the results (of belonging)? Nevertheless, it makes the teams choose their subject matter with a certain level of comfort within the work team. Informally, they demonstrated the existence of an adequate work environment. It is interesting that in the almost 58% of the winning teams had members from different disciplines and, the teams who share the same discipline, were composed of students of different universities or were first year students.

We have observed the existence of two obstacles or situations that slow the dynamics of QPD: a) previous experience with issues in the field of work to be developed and only a small quantity of ideas produced, and b) minimal experience in the subject matter and a large quantity of ideas produced. In other words, if previous experience (previous knowledge of subject matter) produced a reduced number of ideas, what other skills or strategies allow the creative development of the team to improve? The work of T1 and T2 was focused on the strategy of idea definition and development, they took more than 16 hours of idea analysis and selection, while the other winning teams spend less time in the idea definition or selection and took more time to prepare the presentation (see Figure 3 and section 3.2), we observed a strategy of the presentation rather than of creative work. Moreover other questions such as, the influence of the small and bigger team on the creativity, the influence of the previous knowledge, etc. will be the object of future research.

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