

Protocol: Triple Diamond method for problem solving and design thinking. Rubric validation

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Abstract

There is a set of tools that we can use to improve the results of each of the phases that continuous improvement projects must go through (8D, PDCA, DMAIC, Double diamond, etc.). These methods use divergent techniques, which help generate multiple alternatives, and convergent techniques that help analyze and filter the generated options. However, the tools used in all those frameworks are often very similar. Our goal, in this research, is to develop a comprehensive model that allows it to be used both for problem-solving and for taking advantage of opportunities. This protocol defines the main terms related to our research, makes a framework proposal, proposes a rubric that identifies observable milestones at each stage of the model and proposes the action plan to validate this rubric and the model in a given context. The action plan will be implemented in a future research.

Keywords: protocol; problem-solving; design thinking; framework; PDCA; 8D; DMAIC; 6-sigma; process improvement; kaizen

Introduction

Previous research has identified a set of tools that we can use to improve the results of each of the phases that continuous improvement projects must go through (Tschimmel, 2012). As processes/problems become more complex, more structured methods are needed to support these phases, from identifying the problem to creating an action plan. These methods use divergent techniques, which help generate multiple alternatives, and convergent techniques that help analyze and filter the generated options (Clune & Lockrey, 2014; Smalley, 2018). Some of the most cited methods are 8D (Al-Mashari et al., 2005; Camarillo et al., 2018; Gangidi, 2019; Realyvasquez-Vargas et al., 2020), PDCA (Alsayouf et al., 2011; Matsuo & Nakahara, 2013; Nascimento et al., 2019; Nedra et al., 2019; Pinto & Mendes, 2017; Rafferty, 2009; Song & Fischer, 2020;

Wei et al., 2020), DMAIC (Anderson-Cook et al., 2005; de Mast & Lokkerbol, 2012; Easton & Rosenzweig, 2012; Garza-Reyes, 2015; Guo et al., 2019; Marques & Matthe, 2017; Nascimento et al., 2019) and the double diamond (Caulliriaux et al., 2020; Clune & Lockrey, 2014; Senapathi & Drury-Grogan).

Some frameworks have a specific approach to problem-solving (8D, PDCA y DMAIC) (Chavez & Miguel-Davila, 2017; Gomez-Gasquet et al., 2018; Marin-Garcia et al., 2018; Martinez-Martinez et al., 2018; Mazur et al., 2008; Nagi & Altarazi, 2017; Paipa-Galeano et al., 2020; Pinto & Mendes, 2017; Sanchez-Ruiz et al., 2019; Sanchez-Ruiz et al., 2018; Van Til et al., 2009), while double diamond and other approaches linked to design thinking are geared towards discovering opportunities (Beckman, 2020; Buhl et al., 2019; Chin et al., 2019; Dell'Era et al., 2020; Durango et al., 2017; Elsbach & Stigliani, 2018; Geldermann et al., 2018; Mabogunje et al., 2016; Micheli et al., 2019; Mosely et al., 2018). However, the tools used in all those frameworks, and the sequence of steps, are often very similar. In our opinion, this creates some confusion in students when we teach how to use them. They have not just perceived the common core and the aspects that differentiate them. On the other hand, these frameworks have a limited focus and make it unusable to cover the whole set of situations faced by a process improvement team.

Our goal in this research is to develop a comprehensive model that allows it to be used both for problem solving and for taking advantage of opportunities. This protocol aims at: (1) defining the main terms related to our research, (2) makes a framework proposal, (3) proposes a rubric that identifies observable milestones at each stage of the model and (4) proposes the action plan to validate this rubric and the model in a given context. The action plan will be implemented in a future investigation.

Background

The original definitions of problem-solving are linked to overcoming difficulties or avoiding unwanted situations (Hoover, 1990; Isaksen et al., 2000). That is, the focus is on something that is wrong or something that needs to be changed to return to an equilibrium situation. Therefore, the aim is trying to reduce the distance between the current situation and the desired situation of the process (Isaksen et al., 2000). In a broad sense, problem-solving not only applies when there is an obvious manifestation of the discrepancy between reality and desire, but could extend to any environment where, initially, the future situation to which these decisions have aspired is not described, and it is necessary to clarify priorities, to do explicit things that are not fully understood, to design the purpose, decisions, and criteria by which to assess those decisions, and/or to end up modeling how to seize an opportunity not initially expressed (Garcia-Sabater & Garcia-Sabater, 2020; Isaksen et al., 2000; Smalley, 2018; Vernon et al., 2016).

So we can consider that there are several types of situations (Vernon et al., 2016): One, where problems are clear and therefore a rapid and effective corrective action is needed; and another, where the problem is not clearly defined or ambiguity is such that it is not even easy to find consensus on what can be considered a good solution to the situation. Smalley (2018) reaches a higher level of detail, dividing 4 types of problem-solving situations, but types 1 and 2 of its taxonomy could be simplified with the first of the situations described and types 3 and 4 for ambiguous or undefined problems, which fit with design processes.

In both situations, a process of analysis, synthesis, and evaluation needs to be initiated (Design Council, 2007). To do this, different frameworks have been proposed to help in the process. Let us go over some of the main ones. We will start with those who use a single cycle of the process, which are best suited for situations with clear problems. We will continue with those that propose two consecutive cycles and that usually adapt well to design processes or when the problems are not clearly defined or understood at first. From them, we will concrete our proposal of three linked cycles.

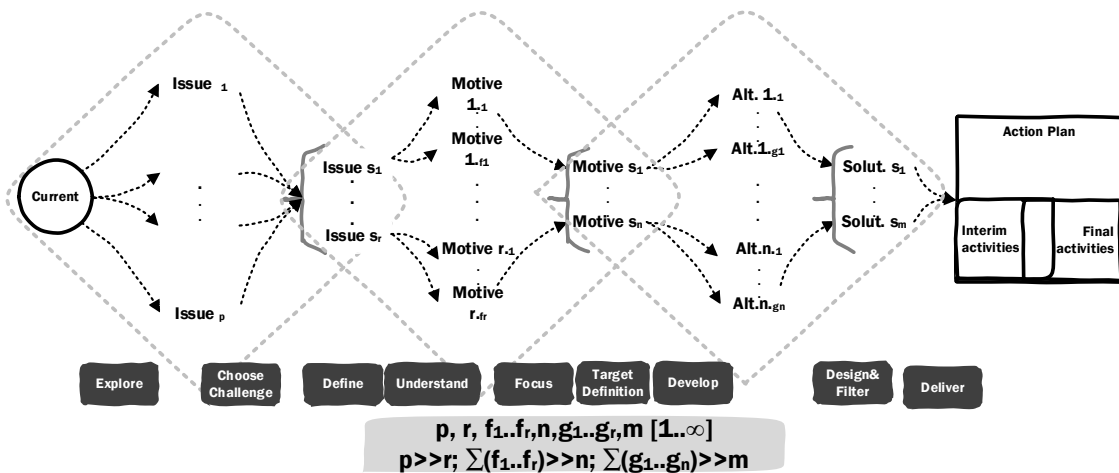
The most basic models propose a process that goes through five stages: defining the problem, analyzing the problem, proposing solutions, evaluating the proposed solutions and, choosing a solution to be implemented (Smalley, 2018). Within this approach, we can place frameworks that modify the number of stages by dividing some of the original stages (Smalley, 2018). For example, there is a 6-stage model (defining the problem, setting the goal, identifying root causes, launching countermeasures, checking results, and standardizing) that became popular around 1960 and which ended up leading to Team Oriented Problem Solving (8D) in 1980. In 8D, a stage is added at the beginning to create the team that will work on the problem, and another is added at the end to recognize the team (Realyvasquez-Vargas et al., 2020; Smalley, 2018). DMAIC framework (define, measure quantitatively, analyze/determine causes, improve -reduce causes-, control) became popular a decade later with the six sigma movement, and returns to the 5 stages, but opens the range of application not only to specific problems but also to more ambiguous situations, such as setting goals or satisfying customer requirements (de Mast & Lokkerbol, 2012; Gangidi, 2019; Sunder, 2016). This puts the DMAIC at an intermediate point between the two types of situations (explicit problem vs ambiguous problem) that we have discussed. However, the purely quantitative approach makes it not a pure tool for the second type of problems.

To deal with ambiguous problems, other frameworks have been proposed since 2000. In its simplest versions, three stages are proposed, as in the 3I model (inspiration, ideation, implementation) (IDEO.org, 2012; Tschimmel, 2012; Vernon et al., 2016). The first phase involves identifying the problem or opportunity to work on and a preliminary data collection to know the current state of the situation. The ideation phase is based on the synthesis/integration of the collected data and the generation of possible alternatives. The implementation phase begins with the selection of the best proposals, followed by the creation of an action plan, implementation, and verification of the results. Normally the stages of the third phase are done iteratively testing solutions until you find one that satisfies the team. This three-stage framework has undergone an evolution in which 6 stages are set that make explicit the steps of the original 3I model (Tschimmel, 2012): understand, observe, point of view, ideate, prototype and test. The initial framework proposed by the Design Council had many things in common with 3I, but it was realized in 5 stages (Design Council, 2007; Smalley, 2018): define the problem, understand the problem, think about the problem, develop an idea, detail a design, and test. They subsequently evolved in 2005 into the double diamond framework (Clune & Lockrey, 2014; Design Council, 2007; Senapathi & Drury-Grogan; Tschimmel, 2012), based on 4 phases: discover, define, develop, deliver. The main contribution of this framework is that it alternates divergent phases (discover and develop) with converged phases (define and deliver).

Given the similarities between the different frameworks, it seems clear that, whatever the situation, the first step should always be to select the problem on which to work and define it explicitly and clearly. Subsequently, we will have to understand the problem and select what are the main criteria that will allow us to

identify if we have achieved a satisfactory result. Finally, we will have to find a way to meet those criteria. Each of these three large blocks of work consists of divergent thinking thought activities, followed by convergent thinking and finished with an explicit statement that serves as input for the next block. At the end of the process, the explicit statement takes shape in an action plan.

Figure 1.- Triple diamond framework (source: authors)



Summarizing all of the above, we propose the triple diamond framework (Figure 1) as an extension and adaptation of the double diamond proposed by the British Design Council (Clune & Lockrey, 2014; Design Council, 2007; Tschimmel, 2012). For this proposal we have integrated ideas present in 3I, DMAIC, and 8D (Cheng & Chang, 2012; Doran, 1981; Scholtes et al., 2003; Shahin & Mahbod, 2007; Suarez-Barraza & Rodriguez-Gonzalez, 2015; Tapping, 2008; Tschimmel, 2012):

1. Explore/discovery: the first triple diamond part represents the improvement project's initial divergent part. This is an exploratory/discovery phase. Here the improvement team will seek possible areas or themes on which to work. It is a matter of identifying possible issues/concerns (problems or opportunities) related to the set improvement focus.
2. Choose challenge: the first diamond's second part is a converging task in which the issues identified in the previous phase are prioritized using a clearly explicit criterion. As a result, a limited number of issues are selected. These will be dealt with by the improvement team. Other issues will be ruled out or recorded and kept until priorities are re-assessed.
3. Define: this step closes the first diamond and helps the second diamond to start. It consists in clearly defining and specifying all the selected issues on which later work is done. If the work team is dealing with problems, using techniques like "Is/Is not matrix" can be very useful for defining problems clearly and explicitly. This technique also helps to summarize the available information and make any gaps that need to be overcome in the next step emerge. If opportunities are being dealt with, only their generalist description can be made in this phase. This is done by

clarifying objectives and linking them to the expected outcomes by describing the current situation, plus other aspects to consider, e.g., establishing the desired tasks, requirements, or characteristics. Hence the group will obtain a framework with which to prepare proposals.

4. Understand: this step opens the second diamond's first phase, which is once again a divergent phase when the information available for all the selected issues is collected. It will often be necessary to collect new information to bridge the gaps to define the issue. To do so, feedback between the Definition and the Understand steps frequently occurs as the definition of the issue is completed or specified. Moreover, new information requirements may appear to complete the understanding of the issue. If the work team is dealing with problems, it should explore the root causes of each problem and not only focus on signs. When the focus is opportunities, perhaps using qualitative techniques, like observation, interviews, or empathy maps, is recommendable to draw up a list of different user requirements.
5. Focus: the second diamond ends with a converging task in which the causes, or requirements, to be worked on in the third diamond are selected using a set of criteria. This selection must be based on the data collected in the "Understand" step. Successful selection depends, to a great extent, on the scope, or cover of the maximum quantity of possible causes/ requirements, the different point of view of related stakeholders, and on the quality of the collected information
6. Target definition: this step closes the second diamond and it clearly and specifically describes the goals so that they are Specific, Measurable, Achievable, Relevant and Time-bound (SMART); or the requirements that the team wants to achieve with the solutions that will be proposed in the next phases. It must also define the criteria by which the alternatives generated in the 7th phase will be selected. These criteria must be aligned with the goals/requirements that are intended to be achieved. Using storytelling tools may help in this phase, given their visual/graphic format, to create a representation of the series of problems/opportunities shared by everyone in the group.
7. Develop: a new divergent step starts with the third diamond. Here many alternatives are generated for each of the selected reasons that act as a focus to base the group's creativity on. All previous efforts made are catalyzed in this phase and projected toward proposing possible solutions. Some alternatives will simply be intuition, and others may be impossible ideas, but act as a lever to create new ideas. Some alternatives may be directly applied as solutions. The most important point in this step is to open as many possibilities as possible without worrying if they are feasible. Deferred judgment techniques (e.g., any of the five brainstorming versions or lateral thinking) or techniques for the systematic opening of alternatives, like the "morphological matrix" or the "concept fan", are very suitable in this phase.
8. Design & filter: the converging part of the third diamond begins by filtering the alternatives in the previous step. To do so, the team applies the criteria, requirements or desired characteristics established in the "Target definition" phase. With the filtered alternatives, a series of solutions is put forward, which may appear from a combination of several, or by improving, or modeling original ideas, e.g., enhancing positive aspects or cushioning negative ones. Using prototypes or pilot trials may considerably help in this phase.
9. Deliver: this is the output (deliverable), where the final proposals are included in an action plan (tasks, dates, people in charge, participants, budget (resources and costs), and training plan). This

plan contemplates all the steps from launching, implementation, verifying outcomes and modifications (if necessary), to standardization and diffusing the solution. This action plan can be well-established in a “business case” that explicitly mentions required investments, the return expected from them, staff training, and risk management

Research objectives

The objectives of this research are:

1. To propose a framework that integrates the stages for problem-solving and taking advantage of opportunities (proposal included in this paper)
2. To validate a rubric to verify the degree to which each stage of the model has been covered (future research applying this protocol)

Expected contribution

Our proposal offers a framework that can be applied in different contexts where it is intended to innovate, either continuously (individually or through improvement groups) or even radically. Whether innovation has to do with solving a problem or seizing an opportunity (Clune & Lockrey, 2014; Smalley, 2018).

In addition, we believe that the rubric can encourage the application of the framework, facilitating the training of the people involved and guiding on the tasks to be carried out at each stage (Vernon et al., 2016).

Finally, this protocol allows other researchers to replicate the validation of the rubric or the model, and extend it to other contexts (Clune & Lockrey, 2014; Smalley, 2018).

Methodology

To check if the framework is viable and fulfills the function for which it is designed, we have created a rubric (table 1 for the English version, annex 1 for the Spanish version) that we will apply in two different situations.

- Situation A: Students will be asked a case that represents an explicit problem-solving situation (Garcia-Sabater, 2020)
- Situation B: A case will be raised that represents a situation with an ambiguous problem, where something new needs to be designed to seize an opportunity (Marin-Garcia, 2020)

We will check if different raters (different teachers or different students) converge on the grades awarded with the rubric. In addition, we will see if the rubric is able to discriminate the process of teamwork, by comparing the triple diamond rubric results with the results of applying a rubric designed to plot problem-solving processes based on the 8D framework (Annex 2 for the English version and Annex 3 for the Spanish

version). Finally, we will analyze the experience of participants through their answer to an open question survey about the usefulness of the triple diamond by comparing it to its way of solving problems before knowing the triple diamond framework.

The data will be obtained with master's and MOOC (Massive Online Open Courses) students, to fit a profile of people with some work experience (even if it was in internship contracts).

Table 1. Rubric (English) for triple diamond framework

Criterion	Insufficient	Low	Medium	High	Excellent
01 Explore	Only explores one problem or opportunity to deal with (probably the obvious one in the description)	↔	Some possible themes are dealt with, but not many (or they do not match reality)	↔	Many themes are dealt with that consider the problem and the company's reality ("p" is many times greater than "r")
02 Choose Challenge	There are no explicit criteria to filter. No evidence for having suitably used a multiple vote, Idea-Rating-Sheets or any technique to prioritize (Pareto, PACE, Decision matrix). The analyses are completely inadequate, or the results have been drawn without respecting the methodology or a suitable protocol	↔	Only uses elemental prioritization techniques, and with no justification. But criteria used are clear.	↔	It suitably justifies the choice of the prioritization technique (simple or advanced) and properly uses it to reason decision making. The selection process is coherent.
03 Define	Not clear about what to deal with or the problem/opportunity to be solved. Unsuitable description of the company's initial situation (its problems and context) and/or the area or process to deal with. Information is confusing or too superficial. No advantages or expected results are discussed. The indicators to be taken to evaluate the results or criteria to be followed to choose among alternatives are neither mentioned nor justified	↔	The description of the situation has been left to one side and there are some gaps (but it can be more or less understood). What is to be accomplished is known, but it is not properly specified or how this will be done is not clear	↔	It clearly explains in detail what is being attempted to be achieved and how it goes about it. What the project contributes to the organization or studied area comes over clearly. The description of all the problems is exceptional: it is clear and quite complete (use of Is/Is not or 5W/1H). It establishes the requirements and desired characteristics after improvement
04 Understand	No drawing is offered to describe the process, nor relevant or reliable data. No evidence for having used 5-Whys or fishbone diagrams or empathy maps or similar. No evidence for having taken data to quantify the effect of the root causes or stakeholders' interest in requirements. At the most, data collection has been inadequately planned	↔	The diagram/s more or less help/s to understand the process. Some data or information are/is lacking. The fishbone diagram (or list of root causes/requirements) is too simple or too brief	↔	The diagram/s is/are quite clear and allow/s the process to be well understood. There are sufficient data/facts to make subsequent decisions. Data are suitable for the pursued objectives. The root cause analysis or point of views of related stakeholders are quite complete. (sum of f1 to fr is many times greater than "n")

05 Focus	There are no explicit criteria to filter. No evidence for having suitably used a technique to prioritize causes or requirements. The analyses are totally inadequate, or the results have been taken without respecting the methodology or a suitable protocol. Inadequate description of all the selected causes or needs	↔	Criteria used are clear. It uses only elemental prioritization techniques that are not justified. At least an Affinity diagram or similar tools is applied. There is a list of causes to fix or requirements to satisfy with clear description	↔	It adequately justifies the choice of the prioritization technique (simple or advanced) and uses it correctly for reasoned decision making related to causes or requirements. The selection procedure is coherent. The description of all the causes is exceptional: clear and quite complete. It identifies the characteristics pursued for the opportunity and the user requirements that it attempts to cover
06 Target definition	No goal definition. No explicit criteria to use in phase 8. No alignment between criteria and goals or requirements	↔	Uncomplete SMART (specific, measurable, achievable, relevant, time bound) goal definition (there are some gaps). Although it is more or less comprehensive, it is not clear that the selected criteria are representative of the situation	↔	SMART goal definition. Clear and coherent criteria
07 Develop	No mention about the different considered alternatives. No evidence for having done brainstorming or used any lateral thinking technique to produce ideas	↔	There are a moderate number of alternatives for the solution (6-15,) most of which are obvious or conventional solutions	↔	It offers many alternatives for the solution, quite a few of them are creative, and some are even irrational. (sum of g1 to gn is many times greater than "m")
08-Filter	No mention about criteria for selection alternatives. No evidence for having adequately used a technique to prioritize. No evidence for having modeled/combined/or promoted ideas. The proposed solutions do not answer the problem or the formulated requirement, and no contingency plans to do so are mentioned. No offer to explain the causes of the successful or unsuccessful intervention	↔	It uses only elemental prioritization techniques with no justification. Ideas are modeled with no criterion or are based on no clear methodology. Adequate conventional solutions are proposed	↔	It suitably justifies the choice of the prioritization technique (simple or advanced) and correctly uses it for making reasonable decisions. The way the problem has been solved is quite clear and coherent. It proposes a set of solutions that derive from the combination, the improvement or from modeling the original ideas. For example, promoting positive aspects or reducing negative ones. It demonstrates the use of prototypes or pilot trials. The results and reasons for success are interpreted or explained. It proposes <u>innovative/original</u> solutions to satisfactorily respond to requirements

9 Deliver	No evidence for having devised an action plan with scheduled activities, nor is there any presentation of something that intends to be an action plan, but it is no such plan. This is superficial and/or contains mistakes and large gaps. No discussion about other possible forms of action, or about the results that could be obtained with them. The limitations of the selected solution and the data collected for the analysis are not presented. How the problem remains is unclear. No sign of the objectives having been met	↔	The presented action plan is not technically perfect. The obtained results are compared with the initial situation, but the alternative explanations to the unforeseen results or limitations have not been finished very well. No mentions required resources, investments, staff training, or the return expected from implementation. No risk management plan is shown	↔	It provides action that is compatible with the PDCA approach. It includes tasks, the people in charge, dates, what will be measured to know if the task has been completed, budget and training activities. The obtained results are compared with the initial situation. It provides alternative explanations for unexpected results and limitations are indicated. A risks plan exists. Costs and returned investment have been estimated
10 Visual	The document is too long, messy, or cumbersome	↔	The document is easy to understand, but is barely visual or denser than necessary	↔	The storyboard is quite clear, visual, intuitive, and easy to follow. Use of storytelling tools for visual representation of the process followed by the group

Workplan

In Table 2 we present the workplan to complete the research.

Table 2. Workplan

Task	Date
Master course data collection	September-December 2021
Master data analysis	February 2022
MOOC course data collection	September 2021
MOOC data analysis	January 2022
Paper submission	May 2022

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Annex 1. Rubric (Spanish) for triple diamond framework

Criterio	Insuficiente	Bajo	Medio	Alto	Excelente
01 Explore	Sólo considera un problema u oportunidad a abordar (probablemente el evidente en el enunciado)	↔	Se abren algunos posibles temas, pero no demasiados (o no ajustados a la realidad)	↔	Se abren múltiples temas, considerando el problema y la realidad de la organización ("p" es mucho mayor que "r")
02 Choose Challenge	No muestran explícitamente los criterios usados para filtrar. No hay evidencia de haber usado adecuadamente un voto múltiple o Idea-Rating-Sheets o alguna técnica para priorizar (Pareto, PACE, Matriz de decisión). los análisis son totalmente inadecuados, o lo resultados se extraen sin respetar la metodología o el protocolo adecuado	↔	Utiliza solo técnicas de priorización elementales sin justificar, pero los criterios usados están claros	↔	Justifica, adecuadamente, la elección de la técnica de priorización (simple o avanzada) y la usa correctamente para tomar decisiones razonadas. el procedimiento de selección es coherente
03 Define	No se tiene claro de qué va a tratar o el problema/oportunidad a resolver. Descripción inadecuada de la situación inicial de la empresa (sus problemas y contexto) y/o del área o proceso a tratar. Información confusa o demasiado superficial. No se argumentan las ventajas o resultados esperados. No se comentan ni justifican los indicadores que se van a tomar para evaluar los resultados o los criterios que se seguirán para elegir entre alternativas	↔	La descripción de la situación la ha dejado en un segundo plano y presenta algunas lagunas (aunque más o menos se puede entender). Se sabe lo que quiere conseguir, pero no acaba de concretarlo o no está claro cómo se hará	↔	Explica clara y detalladamente qué se busca conseguir y cómo. Queda claro cuál es el aporte del proyecto para la organización o área analizada Descripción excepcional de cada uno de los problemas: es clara y muy completa (uso de Es/no Es o 5W/1H). Establece los requisitos y características deseadas tras la mejora
04 Understand	No muestra ningún dibujo que describa el proceso. Tampoco hay datos relevantes o fiables. No hay evidencia de que se haya realizado un 5-Whys y diagrama de espina de pescado. No hay evidencia de que se haya realizado una toma de datos para cuantificar el efecto de las causas raíz o interés de los requerimientos para las personas afectadas. Como mucho se ha planificado, de manera INADECUADA, la toma de datos	↔	Si se muestran diagramas, permiten entender, más o menos el proceso. Hay algunas carencias de datos o información. El diagrama de espina de pescado (o lista de causas raíz o de requerimientos) es demasiado simple o breve	↔	Si se muestran diagramas, son muy claros y permiten comprender el proceso muy bien. Hay datos/hechos suficientes para tomar las decisiones posteriores. Los datos son adecuados para los objetivos de perseguidos. La lista de causas raíz, o puntos de vista de las personas afectadas es muy completo (la suma de f1 a fr es mucho mayor que "n")

05 Focus	No muestran explícitamente los criterios usados para filtrar. No hay evidencia de haber usado adecuadamente alguna técnica para priorizar. los análisis son totalmente inadecuados, o lo resultados se extraen sin respetar la metodología o el protocolo adecuado. Descripción incompleta o inadecuada de las causas o necesidades seleccionada	↔	Los criterios usados para decidir están claros. Pero se usan solo técnicas de priorización elementales, sin justificar por qué no es adecuado usar unas más sofisticadas. Se presenta un diagrama de afinidad (o alguna técnica con el mismo objetivo). Existe una lista de causas a resolver o requisitos a satisfacer que están claramente descritos	↔	Se justifica adecuadamente el modo de priorización usado (simple o avanzado) y se usa correctamente para tomar las decisiones necesarias. El proceso de selección es coherente. La descripción de las causas (o requerimientos) es excelente: clara, completa y exhaustiva
06 Target definition	No hay una definición de los objetivos que se persiguen ni se comentan los criterios que se usarán en la fase 8 (filter). No hay coherencia entre los criterios y los objetivos o requerimientos de la situación	↔	La definición de objetivos en formato SMART (específicos, medibles, alcanzables, relevantes, acotados en el tiempo) es incompleta y faltan algunos detalles. Los criterios que se usarán en la fase 8 son más o menos completos, pero no está claro si son relevantes para la situación	↔	Definición de objetivos SMART. Criterios claros y coherentes
07 Develop	No se comenta ni aporta datos de las diferentes alternativas de solución barajadas y los motivos de elección. No se muestra evidencia de haber realizado una tormenta de ideas o alguna técnica de pensamiento lateral para la generación de ideas.	↔	Hay un número moderado de alternativas de solución (6-15) y en su mayoría son soluciones obvias o convencionales	↔	Hay un número muy elevado de alternativas de solución, bastantes de las cuales son creativas, o incluso algunas descabelladas. La suma de g1 a gn es mucho mayor que "m"
08-Filter	No se comentan los criterios usado para seleccionar alternativas. No hay evidencia de haber usado adecuadamente alguna técnica para priorizar. No hay evidencia de haber modelado/ combinado/ o potenciado ideas. Las soluciones propuestas no consiguen dar respuesta al problema o necesidad formulada y no se comentan planes de contingencia para ello. No explica las causas del éxito o del fracaso de la intervención realizada.	↔	Utiliza solo técnicas de priorización elementales sin justificar. El modelado de ideas se hace sin un criterio o metodología clara. Se proponen soluciones tradicionales adecuadas	↔	Justifica, adecuadamente, la elección de la técnica de priorización (simple o avanzada) y la usa correctamente para tomar decisiones razonadas. Queda claro cómo se ha resuelto el problema y es coherente. Propone un conjunto de soluciones que derivan de la combinación, la mejora o modelado de las ideas originales. Por ejemplo, potenciando los aspectos positivos o reduciendo los negativos. Demuestra el uso de prototipos o ensayos piloto. Se interpretan o explican los resultados y los motivos de éxito. Propone soluciones <u>innovadoras/originales</u> para responder satisfactoriamente a las necesidades

9 De-liver	No hay evidencia de haber creado un plan de acción con la programación de actividades, o se presenta algo, que pretende ser un plan de acción, pero no lo es. Superficial y/o con errores o grandes lagunas. No existe discusión de otras posibles vías de acción y los resultados que se podrían obtener con ellas, o no se exponen las limitaciones de la solución elegida o los datos tomados para el análisis. No queda claro cómo ha quedado el problema. No se demuestra que se hayan cumplido los objetivos	↔	El plan de acción presentado no es técnicamente perfecto. Se comparan los resultados obtenidos con la situación inicial, pero las explicaciones alternativas a resultados no previstos o las limitaciones no están del todo bien acabadas. No se comentan las inversiones, recursos necesarios, formación para la implementación o los resultados esperados de la misma. No hay un plan de riesgos.	↔	Hay un plan de acción compatible con el enfoque PDCA. Incluye tareas, responsables, fechas, qué se medirá para saber si la tarea está completada, presupuesto y actividades de formación. Se contrastan los resultados obtenidos con la situación inicial. Hay explicaciones alternativas para los resultados no esperados y se indican las limitaciones. Existe un plan de riesgos y una estimación de costes y retorno de la inversión
10 Visual	El documento es denso, desordenado o farragoso	↔	El documento es fácil de entender, pero es poco visual o más denso de lo necesario	↔	Guion muy claro, visual, intuitivo y fácil de seguir. Se usan técnicas de "storytelling" para la representación visual de proceso seguido por el grupo en la resolución del problema

Annex 2. Rubric (English) for Group Problem Solving (GPSeng)

	0 points	1 point	2 points	3 points	4 points
01-Define the problem. Using the "Is/Is not" technique	Does not show that the Is/Is not technique has been used	The situation is poorly described and cannot be understood	It is more or less comprehensible	It is quite easily understood	The description is exceptional, clear and most complete
02-Draw a diagram of the process (flow chart or Swimlane, or VSM, or SICOPo workflow)	Does not show any drawing that Describes the process	There is at least one diagram, but the process cannot be understood	The diagram/s allow/s the process to be more or less understood.	The diagram/s is/are very clear and allow the process to be well understood	
03-Symbols of the presented diagrams (if no drawing of the diagram of the process exists, mark the option "no drawing")	There is no drawing	It does not use standard symbols for this type of diagram	The employed symbols are correct		
04-Identify the Root Causes	There is no evidence that 5-Whys and a fishbone diagram has been used	The fishbone diagram does not follow the recommendations of how it must be drawn	The fishbone diagram is too simple or brief	The fishbone diagram is very well done	

05-Data collection	There is no evidence that data collection has been done to quantify the effect of the root causes. Data collection has been improperly planned at the most	Data collection has been SUITABLY planned, but it provides no data	The data collected to quantify the impact of the root causes are incomplete or inadequate	Sufficient data are presented (for the context the exercise is done in) to quantify the root cause of the problem.	
06- Pareto and/or PACE diagram and/or Decision Matrix to prioritize problems/causes/options	No Pareto or PACE diagram, nor a decision matrix, is presented	A diagram/matrix is presented that attempts to be a Pareto/PACE diagram/decision matrix, but this is not the case	The presented Pareto/PACE diagram or the Decision matrix is not technically perfect (it does not assess the data, but how it was built)	The presented diagram/matrix is technically perfect (without assessing data, but how it was built)	
07-Generate alternatives of solutions	There is no evidence that brainstorming or any lateral thinking technique to create ideas have been done.	Barely any alternatives of the solution (2-5)	There are a moderate number of alternatives of the solution (6-15), and most are obvious or conventional solutions	There are many alternatives of the solution (more than 15) and most are obvious or conventional	There are many alternatives of the solution, some of which are creative or even impossible.
08-Affinity diagram	No affinity diagram is provided	A diagram is shown of a different subject to that requested	The affinity diagram contemplates fewer than 20 of the ideas on the list of alternatives	The affinity diagram uses 20 ideas or more, but is somewhat confusing	The affinity diagram uses 20 ideas or more and is clear
09-Select ideas to be implemented	There is no evidence of having used a multiple vote or Idea-Rating-Sheets	There is evidence that a multiple vote or Idea-Rating-Sheets has/have been used, but is/are confusing or illegible or carelessly prepared documents are provided	A multiple vote or Idea-Rating-Sheets has/have been correctly used	There is evidence that a multiple vote or Idea-Rating-Sheets has/have been exceptionally used (most complete, with many participants representing all those involved; well-documented, etc.)	
10-Model ideas	There is no evidence for having modeled/combined/promoted ideas	Ideas are modeled, but not according to any clear criterion or methodology	It has been suitably justified that it is not necessary, or the information about a multiple vote, Idea-Rating-Sheets or other stages in the process have been used to model ideas.		

11-Action plan	There is no evidence for having created an action plan with scheduled activities	Something that intends to be an action plan is presented, but it is no such thing	The presented action plan is not technically perfect (it does not assess data, but how it has been devised)	The presented action plan is technically perfect (includes tasks, responsible people, dates, what is to be measured to know if the task has been completed; it does not assess the data, but how it has been devised)	
12-Documents of Process 8D as OPL	No information is presented as a "graphical script" inspired in OPL	Information is presented as a "graphical script", but phases D1 to D3 are not clearly understood	Information is presented as a "graphical script," but phases D4 to D7 are not clearly understood	A most complete "graphical script" is presented that respects the OPL philosophy	

Annex 3 Rubric (Spanish) for Group Problem Solving (GPSp)

	0 puntos	1 puntos	2 puntos	3 puntos	4 puntos
01-Definición del problema. Uso de la técnica "Es/No es"	No muestra que ha usado la técnica Es/no Es	La situación está pobremente descrita, no se entiende	Mas o menos se puede entender	Se entiende bastante bien	Descripción excepcional, es clara y muy completa
02-Dibujo del diagrama de proceso (diagrama de flujo, o Swimlane, o VSM, o SICOPo work-flow)	No muestra ningún dibujo que describa el proceso	Hay, al menos, un diagrama, pero no se entiende el proceso	El/los diagrama/s permite entender, más o menos el proceso.	El/los diagrama/s es muy claro y permite comprender el proceso muy bien	
03-Símbolos de los diagramas presentados (si no hay dibujo de diagrama de proceso, marca la opción "no hay dibujo")	No hay dibujo	No usa los símbolos estandarizados para este tipo de diagrama	Los símbolos utilizados son los correctos.		
04-Identifica Causas Raíz	No hay evidencia de que se haya realizado un 5-Whys y diagrama de espina de pescado	El diagrama de espina de pescado no se atiene a las recomendaciones de cómo debe dibujarse	El diagrama de espina de pescado es demasiado simple o breve	El diagrama de espina de pescado está muy bien realizado	

05-Toma de datos	No hay evidencia de que se haya realizado una toma de datos para cuantificar el efecto de las causas raíz. Como mucho se ha planificado, de manera INADECUADA, la toma de datos	Se ha planificado ADECUADAMENTE la toma de datos, pero no se aportan los datos	Los datos tomados para cuantificar el impacto de causas raíz son incompletos o inadecuados	Se presentan datos suficientes (para el contexto de este ejercicio) para cuantificar la causa raíz del problema.	
06-Diagrama de Pareto y/o PACE y/o Matriz de decisión para priorizar problemas/causas/opciones	No se presenta ni diagrama de Pareto, ni diagrama PACE, ni matriz de decisión	Se presenta un diagrama/matriz, que pretende ser de Pareto/PACE/matriz de decisión, pero no lo es	El diagrama de Pareto/PACE o Matriz presentado no es técnicamente perfecto (no valores los datos sino cómo se ha construido)	El diagrama/Matriz presentado es técnicamente perfecto (no valores los datos sino cómo se ha construido)	
07-Generación de alternativas de solución	No se muestra evidencia de haber realizado una tormenta de ideas o alguna técnica de pensamiento lateral para la generación de ideas.	apenas hay alternativas de solución (2-5)	Hay un número moderado de alternativas de solución (6-15) y en su mayoría son todo soluciones obvias o convencionales	Hay un número elevado de alternativas de solución (más de 15) y, en su mayoría, son todo soluciones obvias o convencionales	Hay un número elevado de alternativas de solución, algunas de las cuales son creativas o incluso imposibles.
08-Diagrama de afinidad	No se muestra ningún diagrama de afinidad	Se presenta un diagrama de un tema diferente al solicitado	El diagrama de afinidad contempla menos de 20 de las ideas de la lista de alternativas	El diagrama de afinidad usa 20 o más de las ideas, pero es un poco confuso	El diagrama de afinidad usa 20 o más ideas y es claro
09-Selección de ideas a implantar	No hay evidencia de haber usado un voto múltiple o Idea-Rating-Sheets	Se muestra que se ha usado el voto múltiple o Idea-Rating-Sheets pero de manera confusa o con documentos ilegibles o poco cuidados	Se muestra que se ha usado el voto múltiple o Idea-Rating-Sheets de manera correcta	Se muestra que se ha usado el voto múltiple o Idea-Rating-Sheets de manera excepcional (muy completa, con muchos participantes que representan a todos los implicados, bien documentada ...)	
10-Modelado de ideas	No hay evidencia de haber modelado/combinado/potenciado ideas	el modelado de ideas se hace sin un criterio o metodología clara	se justifica adecuadamente que no es necesario, o se ha usado la información de voto múltiple, Idea-Rating-Sheets u otras etapas del proceso para modelar las ideas.		

11-Plan de acción	No hay evidencia de haber creado un plan de acción con la programación de actividades	Se presenta algo, que pretende ser un plan de acción, pero no lo es	El plan de acción presentado no es técnicamente perfecto (no valores los datos sino cómo se ha construido)	El plan de acción presentado es técnicamente perfecto (incluye tareas, responsables, fechas, qué se medirá para saber si la tarea está completada...; no valores los datos sino cómo se ha construido)	
12-Documentación del proceso 8D en formato OPL	No se presenta la información como un "guión gráfico" inspirado en OPL	Se presenta la información como un "guión gráfico" pero no se entiende con claridad las fases D1 a D3	Se presenta la información como un "guión gráfico" pero no se entienden con claridad las fases D4 a D7	Se presenta un "guión gráfico" muy completo respetando la filosofía de las OPL	