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The "Silver lining" methodology for the development of strategic foresight exercises

Abstract

Innovation consists of producing new and more effective solutions to old problems, thanks to technological development. Nowadays, many foresight projects still use methods and techniques that belong to the past century; consequently many think-tanks are still solving old problems with old methods. In this article we are going to introduce an example of innovation in the field of the strategic analysis of future scenarios. The *Silver lining* methodology is designed to help strategic analysts envision and analyse the set of possible future scenarios that can influence the development of a strategic plan. *Silver lining* is a flexible methodology which facilitates the rapid collection and processing of data provided by a range of experts. We use artificial intelligence procedures to process these expert opinions and gather all of them into a single group answer. The methodology has been validated by performance of numerous foresight exercises conducted by the Spanish Institute of Strategic Studies.

Keywords

Strategy, foresight, methodology, futures scenarios, innovation

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Strategic foresight planning

We live our day-to-day lives constantly concerned about the present, the here and now. When we shift that concern to the near future we begin to discover the need for short-term planning or tactical planning. We could say that short-term planning consists of the ordering of tasks or actions with the intention of reaching a specific goal. Planning a weekend trip, participating in a military mission, developing the model for a new car, or even writing this article are all part of tactical or short-term planning.

When our focus shifts from the pursuit of specific objectives to achieving general objectives belonging to a higher sphere, we begin to move into the field of strategic planning. Maintaining a certain social or economic status, a company's business competitiveness or a nation's defence model are all part of strategic or long-term planning.

Our concern for the present means that we pay more attention to tactical planning than to strategic planning. One gets the impression that strategic planning is relegated to a second level compared to tactical planning, and that our activity is almost exclusively geared to the achievement of short-term objectives. In reality, this is not the case. What happens is that we pay more attention to the tangible reality, to the tasks that concern us, than to the ultimate or strategic goal on which we are focusing our tactical planning.

All objectives of a tactical nature obey an objective of a strategic nature; what happens is that sometimes this last objective is taken for granted or is intermingled with other objectives of the same nature.

In terms of its temporality, it seems that first comes "the day to day" and then the future; but this should not be the case, since the future is yet to be built, it is not a deterministic or inexorable future. For this reason, we should be concerned about the future in order to focus the actions of the present on the achievement of future objectives. Consequently, strategic planning should prevail over tactics. That is to say, first the general strategic or long term objectives are set out and next, in order to achieve them, the partial or short term plans are formulated, bearing in mind throughout their development that they are all oriented towards the achievement of strategic objectives.

Objectives of strategic planning

From the smallest organisation with just one person to the largest company or organisation with thousands of workers, all of them express their objectives in terms of strategic planning and tactical planning (in that order).

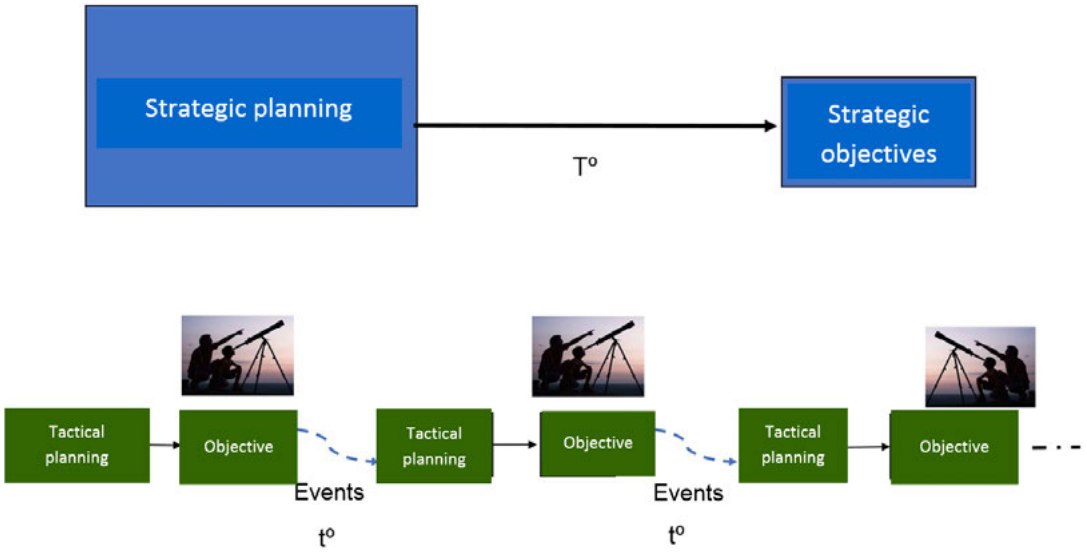
Strategic planning often seems to be less important than tactical planning because its objectives are implicit and not formally or explicitly expressed. Individuals do not formally document or communicate their strategic plans, but they tend to do so with

tactical planning, such as when they have to prepare a budget for a trip or when they book flights or accommodation after the budget has been accepted, or when they make a list of what they will need to pack. All these actions involve calculation and note-taking activities that are present in our memory, while the strategic objectives that prompted us to carry them out took only a few minutes of reflection.

On the other hand, organisations that move in a competitive or risky environment are forced to constantly innovate and revise their strategic plans and they also need to make their strategic objectives explicit in a formal way so that the governing body of the organisation is aware of them, shares them and aligns its decisions around these objectives. As events unfold and the scenarios with which the organisation is faced change, the strategic objectives must be reviewed and, consequently, all strategic planning must be revised (Castillo, 2012a).

Therefore, stability, coherence, collectivity and competitiveness are the main characteristics that mark strategic plans in an explicit and formal way.

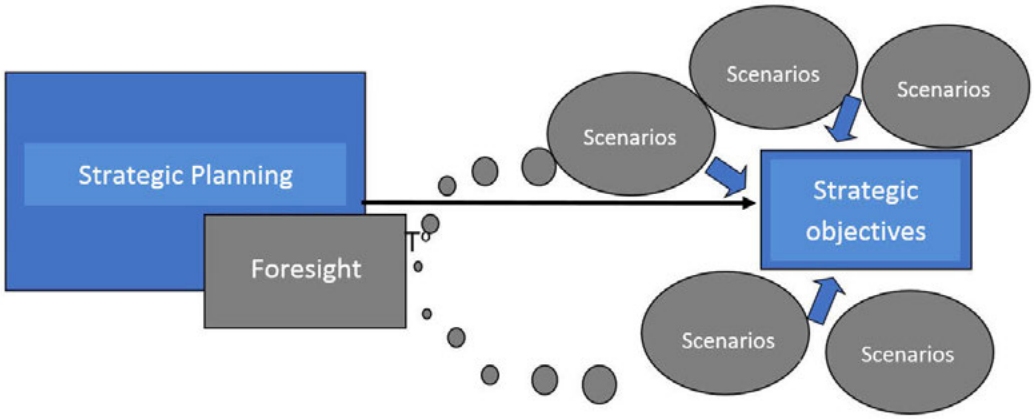
Large national and international companies regularly update their strategic plans at intervals of no more than five years. The time period for updating strategic plans depends on the stability of the system in which they are developed. In stable systems, it is possible to shorten the updating period of the strategic plan considerably, while in unstable systems exposed to variability, there is a need to check that the strategic plan is adjusted to the succession of scenarios modified by unforeseen events. Accordingly, strategic planning places special emphasis on the objectives to be achieved and on the means and ways of achieving them, whereas tactical planning focuses on achieving short-term objectives, without losing sight of and always geared towards achieving strategic objectives.



The relationship between strategic and tactical planning

On the other hand, foresight aims to foresee possible futures and the possibilities they present to us.

Although foresight and strategic planning are intimately related, it is important to distinguish between the two. Foresight, as such, asks what can happen and what can be done. Strategic planning, however, starts with action itself, since it asks what am I going to do and how am I going to do it. Strategic planning needs foresight to complete the analysis of possible futures before taking action.



The relationship between strategic planning and foresight

The analysis of possible scenarios plays an essential role, since the achievement of strategic objectives will be strongly conditioned by the characteristics of the scenario that ultimately becomes a reality in the future.

Foresight

Foresight is defined as the science of studying possible futures within the field of strategic planning (Bas, 2013). An organisation turns to Foresight to analyse which of the possible futures best suits its interests.

The true usefulness of Foresight is based on its capacity to drive strategic decisions, with the intention of achieving a desired future.

Foresight analysis allows one to visualize possible undesired future scenarios that could be avoided if a series of smaller decisions are made that can redirect the future towards a more favourable situation.

Participants in a foresight study

The essence of Foresight lies in collective reflection, which is why it is necessary to have teams of people who carry out the processes described in classic foresight methodology.

Traditionally, foresight studies are conducted by two groups with different profiles and specialisations. The first group is made up of analysts who belong to the organi-

sation and have a perfect knowledge of its needs and objectives. The second group is made up of experts who are usually independent and have extensive experience in the areas on which they are consulted.

The expert group is comprised of people with experience in the field of study, whose mission is to make informed estimates, which will be contrasted with the opinions of other experts with a view to carrying out the successive phases of the method. The experts must know the system in question, and have the capacity to analyse its flexibility to change and evolve.

The analysis group has the task of controlling the consultation process with the experts by confirming and consolidating the experts' individual responses, converting them into group feedback, but ensuring that their interpretation is unbiased at all times.

The scenario method

Foresight methodology seeks a desired situation for the organisation in all its possibilities, considering its inherent characteristics and competencies. The objective is to propose strategic actions in the context of the scenario in which they are developed.

A scenario is a set formed by the variables illustrating visions of a possible future situation. However, any set of hypotheses is often mistakenly described as a scenario.

Scenario planning consists of representing possible futures and the path that leads to them, looking for the strongest trends and points of instability that may occur within the organisation, in its rivals and in the general environment.

The scenario method is an ideal, comprehensive procedure for analysing and reinterpreting the information collected through other techniques, whether explicitly forward-looking or not.

Finally, when drawing up scenarios it is necessary to take into account the following:

- Carrying out a correct definition of the object studied and its scope.
- Updating environmental knowledge, both at the present time and with regard to its future prospects. This environment determines the variables that will make up the scenario.
- Definition in quantitative or qualitative terms of the behaviour of the variables. It is important to bear in mind that the information obtained has to underpin the development of a set of hypotheses that relate the causes to the behaviour of the different actors.
- Each set of hypotheses will usually result in a certain scenario. Scenarios should be mutually exclusive; however, this does not mean that the same conclusion can be reached with different scenarios.

– In order to serve as a basis for decision-making and for eliciting expert opinion, scenarios must be concrete, concise, understandable and possible.

– Finally, given that scenarios are the basis on which information is obtained, it is essential to reflect on the way in which the scenarios will be presented in writing (Biermann, 1986).

The Delphi method in scenario analysis

According to the mathematical scientist Norman Dalkey (Dalkey, 1972), the Delphi method is used to obtain the opinions of a specific group of experts in relation to a specific field or area of consultation. The process has the following characteristics:

– Feedback is anonymous. Opinions of members of the group are obtained by formal questionnaire.

– Iteration and controlled feedback. Several consultation processes are carried out on the same subject. Feedback from one round serves as input for the next.

– Group feedback. By applying statistical techniques, an appropriate aggregate of individual responses is achieved.

The Delphi method requires the participation of a group of experts and a group of analysts.

Its goal is to collect the opinions of a group of experts in order to arrive at a certain degree of consensus (Turoff, 2009).

This is achieved by sending several successive questionnaires to the group.

The method consists of the following stages:

– Presentation of the issue to be addressed through a questionnaire that poses specific, objective and to some extent measurable questions.

– Selection of the expert group. Regardless of the supposed knowledge of the subject to be dealt with, the expert must have a "future-oriented attitude ", namely the ability to face the future. Experts are interviewed by mail, so that their opinions are independent.

– Consultation and analysis of results. The first questionnaire is sent to a large number of experts, who, apart from answering the questions, must also evaluate their own knowledge of each question. In the second round of questions, the experts are informed of the results of the first round and asked to respond again, justifying their response where there is a strong divergence between them and the group. If necessary, the third round of consultation asks for comments on the divergent aspects. A fourth round allows for an average consensus opinion and a range of differing views.

Cross-impact analysis

One of the shortcomings of the Delphi method is that it does not take into account interaction between events. In order to solve this problem, the Cross Impact (X-I) method was developed, which not only takes into account the opinions expressed about individual events but also the interdependence of events. It therefore provides a more global vision in line with the aims of Foresight.

This method seeks to determine the changes that can occur in certain hypotheses due to the simple and conditioned probabilities they possess caused by their interactions.

Under the umbrella term of Cross Impact, other methods have appeared that simplify its application, such as the SMIC techniques (Duperrin, 1975) (Duval, 1975), or ExplorSIM, whose objective is the search for the most probable of all possible future scenarios by simplifying the generic calculation of the Cross Impact method.

The stages of the cross-impact method can be described as follows:

- Formulation of the hypotheses. Due to the large number of scenarios generated from a large number of hypotheses (2^n), it is not possible to establish a large number of these.
- Selection of the experts. As with all expert methods, a selection of experts is needed who not only have a broad knowledge of the subject matter, but also a prospective attitude.
- Probability of the scenarios. All possible scenarios are ordered according to the greater or lesser probability of their occurrence, starting with the most probable up to a certain limit of accumulated probability.

Evaluation of the choices and their associated strategic options.

Adjusting Bayes' conditional probabilities

This consists in applying the formulas derived from Bayes' Theorem to determining the so-called conditional probabilities.

An overview of classic foresight methodology

The generic phases into which the strategic planning process using foresight procedures can be divided can be summarised as follows:

- Presentation of the problem and analysis of key events.
- Selection of the expert group.
- Consultation with experts on the probability of occurrence of the key events.
- Application of the Delphi method to bring the expert group to a common assessment of the estimated probabilities.

- Consultation with experts on the conditional probability of the occurrence of key events using the cross-impact technique.
- Application of the Delphi method to lead the expert group to a common understanding of estimated probabilities.
- Use of Bayes' theorem to perform an "a priori" probability adjustment.
- Selection of the most probable scenarios within the wide spectrum of scenarios.
- Comparison of the probabilities obtained for each scenario and selection of the most likely ones.

Initially the group of analysts selects the issue to be studied and provides a list of possible events related to the future scenario.

The expert group rates the influence of events in terms of probability of occurrence. The Delphi method (Dalkey, 1972; Linstone, 2010) is used to lead the group to a common response. Because of the use of conditioned probabilities, it is necessary to apply Bayes' theorem to adjust them accordingly. Analysts then proceed with the collection of scenario probabilities. The scenarios with the highest probability of occurrence will be subject to a more detailed analysis. At the end of the process, a matrix is obtained, which represents the probabilities of the most representative scenarios and the events comprising them.

The following figure illustrates an example of a matrix with ten scenarios with the greatest likelihood of occurrence out of a possible two hundred and fifty-six (2^8) involving up to a total of eight events (listed in the first column). The last line expresses the probability of occurrence of each scenario in a hypothetical example.

Ev	Scen1	Scen2	Scen3	Scen4	Scen5	Scen6	Scen7	Scen8	Scen9	Scen10		
1			■					■		■		
2					■		■					
3												
4							■		■			
5		■		■						■		
6			■			■				■		
7												
8		■										
Prob.	0.067	0.059	0.048	0.045	0.037	0.029	0.022	0.022	0.021	0.014	Σ Esc=	1.00

Grey cells: the event does not exist

Grey cells: The event does not exist. Probability of scenarios

According to the axioms of probability, the sum of the probabilities of all the scenarios that can be generated with the participation of the eight events has to be equal to the unit.

Criticism in relation to the application of classic methods in Foresight

There are certain flaws in the classic prospective method which have been the subject of criticism from the scientific community (Hsu, 2007). The following is a list of the most relevant issues:

- Probability is defined as the relationship between the number of times an experiment has a positive result and the total number of possible cases. In terms of strategic planning, the use of probability as a means of measurement does not seem appropriate, as the situation or scenario has not occurred before and the total number of possible futures would be unpredictable.
- Although the Delphi method is applied with independent experts without direct communication between them, the use and dissemination of the average feedback in the successive four phases of the method can nevertheless condition the expert group' freedom of response.
- Human logic, and especially that of the experts, when grading conditioned probabilities does not naturally accept the adjustment that must be made when formally applying Bayes' theorem on conditioned probabilities.
- Although from a quantitative point of view it is possible to discern which of the scenarios has a higher probability, the poor resolution between them makes the certainty of its occurrence disappear. An illustration of this can be found in the previous figure where the probability obtained for Scenario 1 is 6.7% and for Scenario 2 is 5.9%. In quantitative terms the probability of the former is higher, yet it is almost guaranteed that neither will happen.
- With the application of this procedure, we are not aware of the more sensitive events on which action could be taken with the aim of consolidating or avoiding a given scenario.

The "Silver lining"methodology

Silver lining is the name given by the creator and author of this article to the methodology for conducting foresight exercises based on fuzzy techniques for the elaboration of expert opinions. Some of the benefits of these techniques

were published in a previous article (Castillo, 2012b)[1], techniques that are now integrated into the processes of the methodology and detailed in the work «*Planeamiento estratégico. El diseño del futuro a través de las opiniones de expertos*» (Castillo, 2015).

This methodology is intended to provide an alternative solution to the formal difficulties presented by the application of traditional procedures when carrying out foresight exercises, but without losing sight of the general objective for which forecast techniques had been traditionally applied.

The aim is to make foresight exercises affordable in terms of time and cost by processing expert opinion using procedures based on innovative technologies.

Silver lining is an adaptable tool that provides the manager-strategist with the possibility of obtaining information by processing the opinions of a group of experts with the aim of supporting their decisions. In this way a manager can make decisions in an active and justified way aimed at adopting attitudes and measures to consolidate or avoid future scenarios.

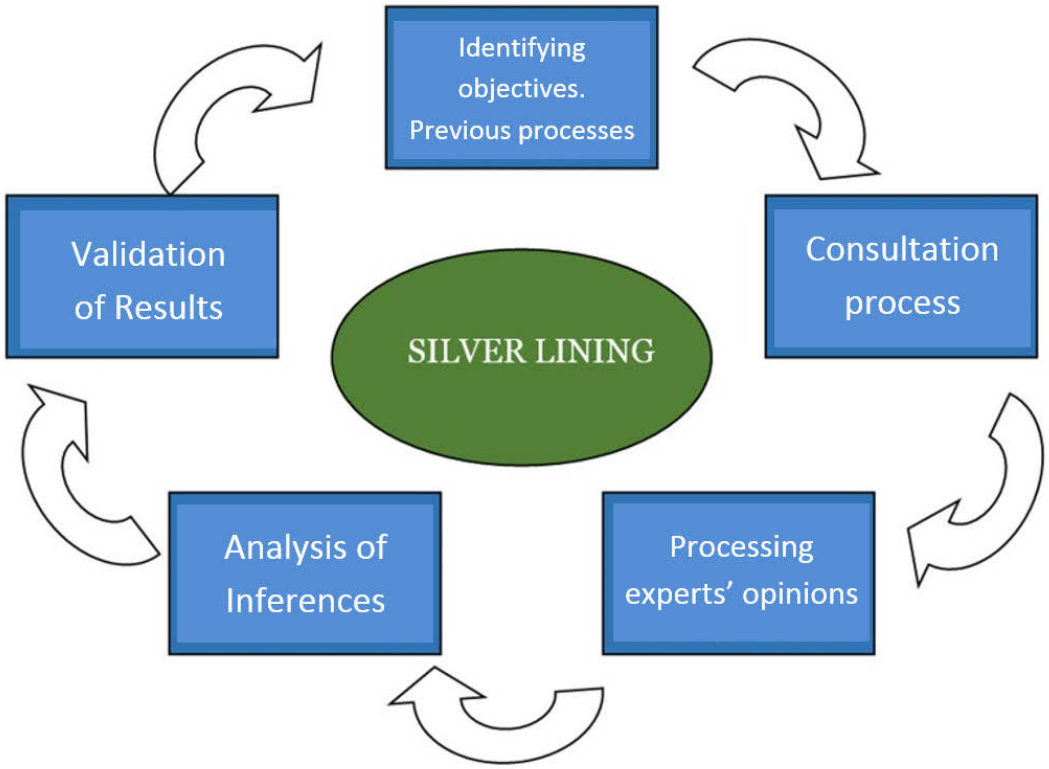
According to the positive idea of constructing a future from a diversity of events, the author has entitled the methodology "Silver lining", a term that conveys hope and light after the storm.

Phases of the Silver Lining Methodology

The general procedures of the Silver lining methodology are as follows:

- Identifying objectives. Preparation and previous processes
- Consulting experts
- Processing experts' opinions
- Analysing inferences
- Validating results

1 It is possible to view the content of this article in its entirety at http://www.ieee.es/Galerias/fichero/Revista_Digital/RevistaIEEE_Num_0.pdf.



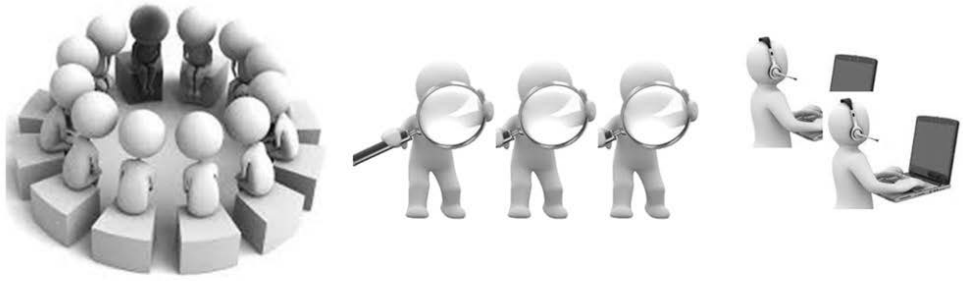
Silver lining general procedures

Normally, anticipatory foresight exercises are interlinked. The centres or departments that carry out this type of study generate foresight exercises on a continuous basis. There is feedback between successive exercises. Thus, isolated exercises that do not provide continuity in the analysis of the future would not be consistent with the ultimate objective of Foresight. Hence the need to create foresight centres or departments in large organisations or companies, providing continuity in the adaptation of strategic plans to future scenarios analysed through foresight.

Participants in a foresight study

Traditionally, two groups have been involved in carrying out a foresight study: analysts and experts.

The *Silver lining* process requires a new group of participants who know how to extract solutions from new technologies that facilitate the foresight process. This is the so-called group of "ICT Specialists", who are given the responsibility of collaborating with the analysts in the preparation of scenarios, consulting experts via the Internet, selecting sensitive events after the first round of consultations with the experts, extrapolating scenarios with neural networks and obtaining the group feedback with fuzzy logic.



Participants in a foresight study

Methodology Processes

Identifying objectives. Preparation and previous processes

1. Selection of scope, range and time frame
2. Identifying the stability of the system or environment
3. Selection of participants and job profiles
4. Selection of expert group
5. Evaluation of expert group
6. Selection of events

Organising consultations

1. Drafting of questionnaires. Round 1
2. Consultation. Round 1
3. Qualitative data processing. Round 1
4. Selection of sensitive events
5. Preparation of questionnaires. Round 2
6. Consultation. Round 2
7. Qualitative data processing. round 2
8. Confirmation of sensitive events

Processing experts' opinions

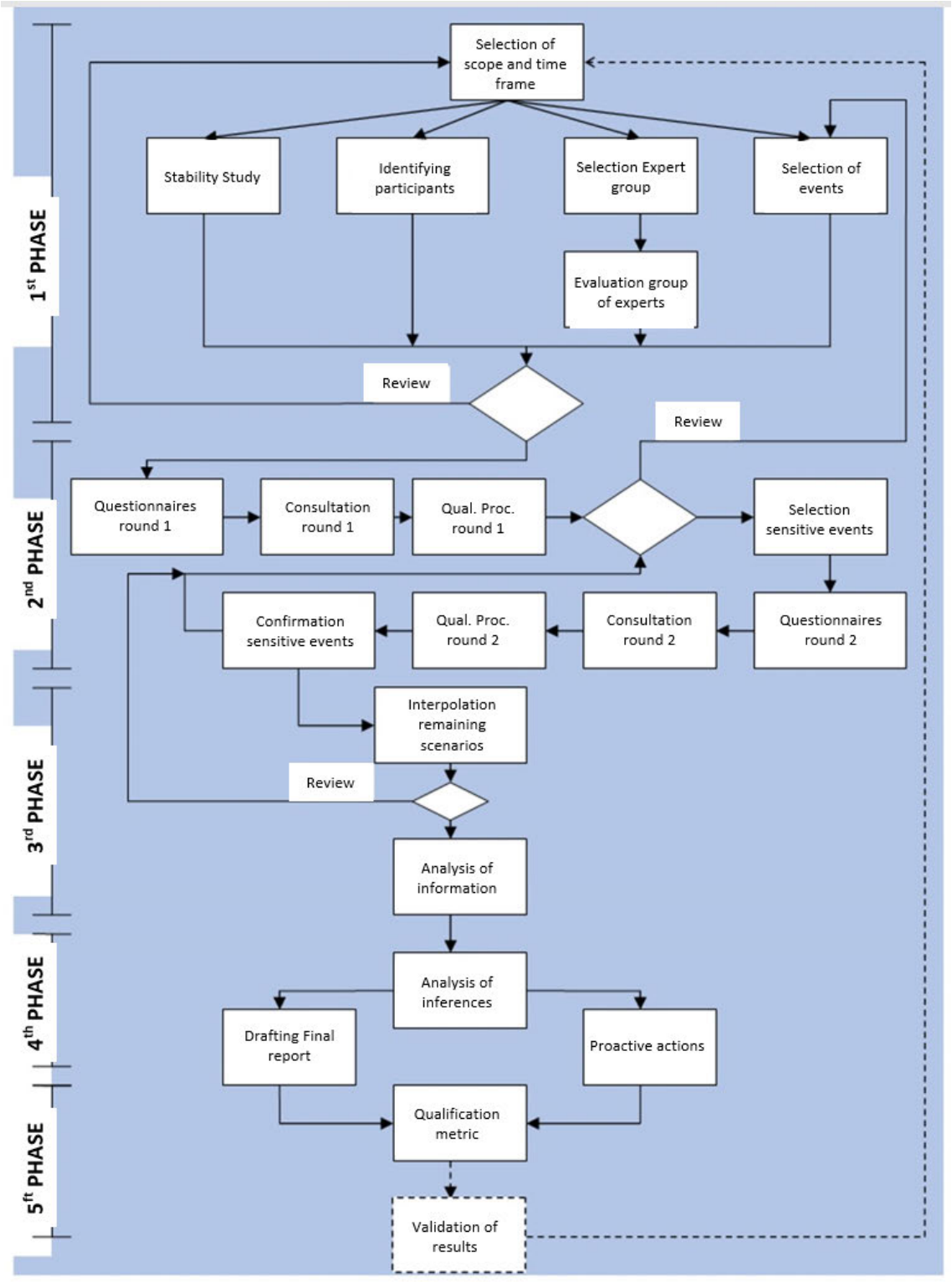
1. Interpolation and validation of opinion on remaining scenarios
2. Information analysis

Analysis of inferences

1. Analysis of inferences from environment
2. Drafting final report
3. Proactive actions

Validating results

1. Qualification Metric Methodology Application
2. Validation of results



Silver lining flow chart

Most of the methodology processes are not carried out sequentially.

The processes included in the first phase 'Identifying objectives. Preparation and prior processes' may be developed almost simultaneously since they are activities that do not require any input from previous processes. Most of them are based on the selec-

tion of the scope and time frame of the study. The evaluation of the group of experts can only be done after the selection of the group components.

Once the first phase of the methodology has been completed, it is important to consider whether the appropriate foundations have been laid for the exercise to proceed, or whether some of the previous processes ought to be reviewed, the scope of the study reduced, the number of experts increased or whether the study should be discarded altogether due to the instability of the system as a whole for which a foresight study cannot be guaranteed with any degree of certainty.

The processes included in the consultation phase of the methodology are sequential, that is to say, each one receives information from the previous one, with the exception of those cases in which an incorrect selection of the event has been detected or there is certain ambiguity in their interpretation by the experts. In the latter case, it may be necessary to reconsider the selection and definition of the events that may be part of the scenario in the first and second rounds.

In the third phase of the methodology the opinion of the experts is processed and the knowledge elicited from the experts is interpolated to the rest of the scenarios not consulted and the information is analysed. An analysis of inferences is conducted in the fourth phase of the methodology which is composed of three tasks that can be developed simultaneously.

Finally, the fifth phase of the methodology is focused on checking the quality and validity of the exercise. The first activity is carried out at the end of the foresight exercise while the second is extended over a period of time and aimed at verifying whether the foreseen future is materialising in the way it was expected. This latter activity is recursive, since it will encourage a new study in the event that the forecast has been wrong or the course of events has changed the initial premises.

Selecting scope, range and time frame

One of the first activities at the beginning of a foresight exercise is the selection of the goals of the study. To do this, it is necessary to define the problem to be addressed and to frame it within a specific time frame. Let us not forget that our society operates in a dynamic system in which one of the main variables is time and the other is the set of events or actions that can influence it. When you set a time frame, you are specifying a period of time in which certain events are expected to have an influence.

The selection of the scope outlines and delimits the problem. Statements for a foresight project such as "The technological future in Spain in 2025" only define the scope. Starting a foresight project with this sole delimitation will lead to ambiguity and lack of definition. This does not preclude the exercise, since it can be carried out, but the results will be as extensive and general as the statement of the exercise. It is therefore necessary to define the range of the study within the scope described. For example, we could specify the statement of the previous example with "Influence of the Spanish automotive industry on the Spanish technological future in 2025". The scope of the

study has thus been limited and possible scenarios will be obtained that are limited to the automobile industry within the Spanish technological environment.

From a strategic perspective, Foresight has always been linked to a distant time frame because it goes hand in hand with Strategic Planning. Notwithstanding, foresight techniques can be applied to shorter periods of time. Specifically, they can be applied in decision-making procedures regardless of the time period in which the decision is to be made. Decision on a business merger that can be considered in a few weeks, the international expansion of a company due to a specific window of opportunity, the investment in certain assets in the stock market, or a political decision in response to an unexpected economic situation are all examples that require a foresight study and are not framed in a distant timescale, although they fall within the framework of strategic planning.

Identifying the stability of the system or environment

Identifying the issue that is the subject of foresight is not sufficient for describing the environment and its evolution. It is essential to know whether the issue under consideration is part of a system that is deemed stable or whether, on the other hand, the system is subject to multiple fluctuations due to uncertainties that may or may not be quantifiable.

The lack of stability of the system or uncontrolled instability may mean that the foresight exercise should not be carried out or that its scope and reach should be reduced to sub-problems in which instability is limited. If a foresight exercise were carried out on a system with uncontrolled instability, the result would only be valid within a short period of time. This circumstance may need to be acknowledged and justified in the results of the study.

At the end of this process, the system should be qualified as "stable", "unstable" or "chaotic" and the reasons provided in support of whichever qualification is selected.

Selection of participants and job profiles

As explained in section 4.2 "Participants in a foresight study", experts, analysts and ICT specialists should be included in the foresight study.

It is possible that the agency that decides to undertake this type of study will have all three groups of participants, which would make the project more adaptable and compartmentalised. In certain organisations, the analysts may also act as experts, or the analysts may also assume the role of data processors as ICT experts. In both cases, although there may be a certain economy of resources, it is possible that the results obtained may be biased or that the efficiency of the procedure may be negatively influenced. If the analysts were to take on the experts' tasks, this would reduce the scope of experience on which the answers are based, almost to the point of invalidating it. On the other hand, the overlap between the roles of ICT specialists and analysts would also lead to limitations in the technological resources that could be employed.

At the conclusion of this methodology process, the participants and their job profiles should be identified, justifying the reassignment of tasks between groups, as required.

Selection of the expert group

At this point in the methodology, two questions arise: Who should we select as an expert, and how many experts do we need?

As far as the first question is concerned, we must rule out the choice of friends or acquaintances simply because we have a fluid relationship with them. We should also rule out analysts, who at some point may be influenced by the very management of the reflection process.

In the first instance, personnel should be chosen with experience in the field of prospective analysis and with special skills in discerning consequences and interactions.

People need to receive a certain reward for their work; this is inherent in human psychology. Experts can be rewarded for their participation in the form of financial compensation, or in the form of acknowledgement, appreciation and increased prestige for participating in this type of exercise. Whatever the means of compensation used, it must ensure that experts are sufficiently motivated to focus their undivided attention, albeit on a one-off basis, when responding to the questionnaires.

The number of experts ought to be sufficient to generate feedback that is appropriate to the problem in hand (Ludwig, 1997)[2]. A minimum of fifteen experts is desirable and will depend on the type of exercise, the maximum being determined by the possibility of handling the entire foresight process smoothly.

On completion of this process, a list of experts will have been obtained, the reasons for their selection and the number of experts that would be desirable.

Evaluation of the expert group

The experts are assessed individually, since the aim is not to form a team but to extract individual opinions from each of them.

In validating the choice of the expert group, the following factors will be taken into account:

- The result of the validation of their opinions in previous exercises
- Their experience
- Their prestige
- Their social intelligence
- Their intrapersonal intelligence

2 To complete Ludwig's contribution (Ludwig, 1997), we can affirm that the ideal expert group would be composed of a number of experts with the capacity to generate answers whose judgment would be representative with regard to the problem in question and who possess a homogeneous and high level of social experience and intelligence.

If the organisation has a database or history of previous foresight exercises in which the expert has participated, it will be able to check the validity of their opinions over time. This may be the main method of evaluating the quality of an expert.

In the case where an expert has been selected for the first time, the other four factors should be analysed. Both their experience and the accuracy of their opinions can be ascertained through their curriculum vitae and through references from their participation in other organisations.

Intrapersonal intelligence reveals the individual's ability to have a real image of his/her own person, while social intelligence reveals the ability to foresee relationships and consequences of events that occur in a given scenario. Both intelligences are measurable by means of an "ad hoc" testbed.

It is recommended that any organisation that conducts foresight exercises on an ongoing basis should have a department or team of experts in which to conduct its own selection tests.

At the end of this process of the methodology, the suitability of each of the experts in the group should have been ascertained (Castillo, 2019)[3].

Selection of events

The definition of events is a fundamental part of the foresight study. A good definition of these events will ensure that the scenario is uniformly understood by all the participants, while an ambiguous definition will not allow the exercise to progress quickly. For this reason in foresight exercises in which *Silver lining* is employed, the validity of the definition of the events must be corroborated after the first round of consultations with the experts. Should it be concluded that the definition is either deficient or ambiguous, a return to the process of defining the events will be considered necessary.

Events are happenings that influence or characterise a certain scenario. Events must be independent of each other and should not, in principle, be the cause or consequence of other events that are part of the same scenario. For example, if A is part of B, when B happens it is possible that A will also happen.

If both events are intended to appear in the scenario, it is quite possible that there is an event C that encompasses both of them; therefore, it is preferable that event C be part of the scenario instead of events A and B.

There are two initial and normally mutually exclusive situations when it comes to choosing events:

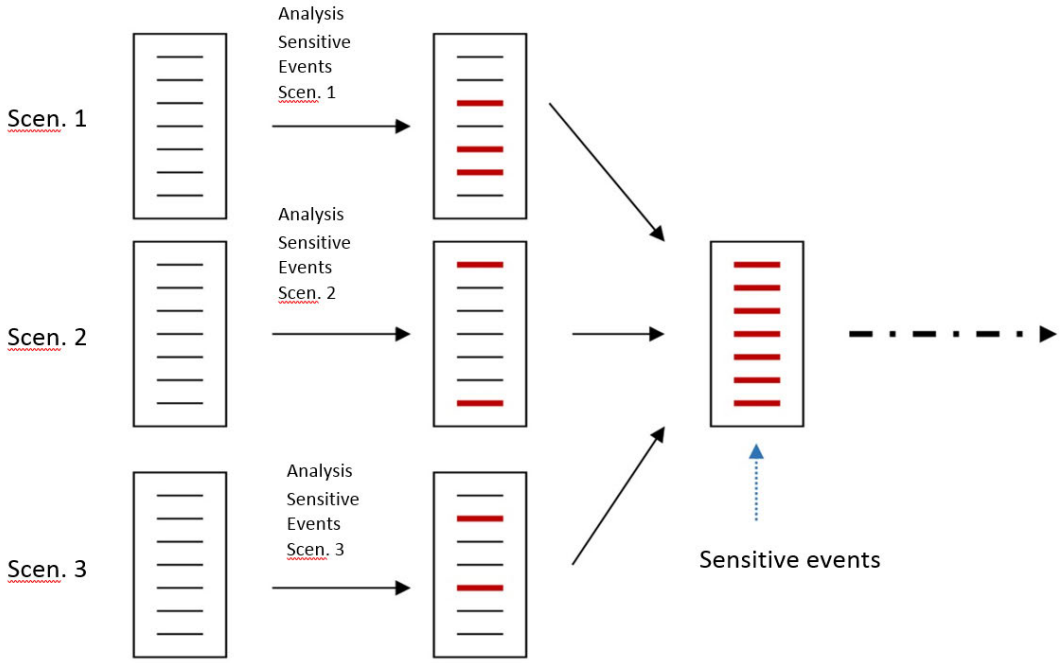
- The analysts know the main events of the problem in hand.
- The analysts have a general idea, but are unable to pinpoint the main events

3 The opinion article entitled «The profile of the perfect strategist» sets out the characteristics that are required of a genuine expert and how to select one.

In the first case, the group of analysts selects the events; while in the second case, they need support in order to make their selection. In this second case, it would be advisable to carry out a brainstorming exercise with the group of experts.

This exercise consists of asking the group of experts a generic question, in which it is put to them that with a degree of imagination and based on their experience they list some of the key events that would form part of the study problem (Castillo, 2015).[4]

The number of events conditions the total number of scenarios that can be generated in a foresight exercise. With seven events, 128 scenarios can be generated (2^7). This could limit the study of complex scenarios in which it is necessary to handle a higher number of events. Should it be necessary to work with a significant number of events, it is possible to group the scenarios into cascades. This would involve carrying out several linked studies on scenarios that are related through new events and sensitive events. The process would consist of prioritising the list of events and dividing it into groups of seven events. Subsequently, experts would be consulted with a view to arriving at the sensitive events for each of the groups of scenarios consulted.



Cascading scenarios

In the case of sensitive events, a new list of seven events would be compiled and the process outlined in *Silver lining* would be continued until its completion.

By way of comparison, traditional procedures use complex algebraic processes to reduce the number of events by analysing dynamic scenarios (Turoff, 2015).

4 In (Castillo, 2015) Case Study 3 (Chapter 11 of his doctoral thesis) a previous brainstorming exercise is developed for the selection of events.

Drafting of questionnaires. Round 1

In a typical case where it has not been necessary to undertake the process of generating cascade scenarios, the analysts will have generated a list of events with a number not exceeding seven that could form part of the scenario for consultation.

The analysts will order these seven events in order of possibility of occurrence and, in the event of equality, importance will prevail. The ordered list will be sent to the ICT specialists, who will draw up fifteen out of the one hundred and twenty-eight possible scenarios in which a representative mix of the most important and the least relevant events appears.

The consultation process. Round 1

Today, ICTs play an important role in carrying out consultations. Internet-based mobile technologies facilitate the delivery of information to individuals in real time and their feedback is either synchronous or asynchronous depending on the availability of the user.

Furthermore, when consulting a group of experts, it is necessary to ensure secure access and individualised feedback. To this end, it has proved extremely useful to send an e-mail with a personalised link or access that, by correctly identifying the experts, allows them to navigate between the different questionnaires on which they are consulted.

Consulting on a given scenario

On the other hand, the consultation aims to be as intuitive as possible; so that on simply reading the questionnaire, which contains the scenario with the events that comprise it, the expert only has to select from a drop-down list if he/she considers that the possibility of the scenario occurring is "Very High", "High", "Medium", "Low" or "Very Low".

Qualitative data-processing. Round 1

Once the deadline for feedback from the experts has passed, the responses provided by the experts are analysed. A first analysis is made concerning the questionnaire and the expert's understanding of the process.

Regarding the questionnaire, the experts' answers are usually grouped according to a central value, which allows us to see a certain amount of variation.

Very High	0	1	0	2	2	1	0	0	0
High	0	1	1	4	1	2	1	5	3
Medium	0	2	1	8	8	5	2	5	7
Low	2	6	5	0	3	5	4	4	3
Very Low	12	4	7	0	0	1	7	0	1
Total	14	14	14	14	14	14	14	14	14

Grouping of expert responses and their breakdown in a consultation process with 14 scenarios and nine experts (represented in each column)

As far as the expert's understanding of the process is concerned, it is also necessary to analyse whether there is any dispersion in his/her responses or whether most of them have the same qualification.

Individual questionnaires results

Very High	High	Medium	Low	Very Low	Total
1	3	5	4	2	15
0	3	4	3	5	15
5	2	7	0	1	15
0	3	4	0	8	15
2	4	1	6	2	15
0	1	2	5	7	15
0	0	10	5	0	15
0	2	4	5	4	15
0	3	9	1	2	15
0	0	1	5	9	15
1	5	8	0	1	15
0	0	2	10	3	15
0	0	3	6	6	15
2	1	3	1	8	15

For example, in this figure we observe a range of responses from all the experts with the exception of the responses given by expert number 7, who has qualified the fifteen questionnaires exclusively between the values "Medium" and "Low".

In an initial estimate, these two indicators confirm the quality of the selection of events and the questionnaire, as well as the suitability of including any given expert in successive rounds (in the previous case, expert 7 should not be included in the next round).

Once this assessment has been made, the experts' answers need to be converted into rules, in the form

IF "Event_Num#Exists" And « EventoNum#_ Exists"

THEN "Possibility_Ocurrence_Value"

- The set of all the rules generated by the experts will form the fuzzy inference module.
- If we assume a total of fifteen questionnaires for the first round and a number of
- thirty experts, we get an inference module made up of four hundred and fifty rules.
- When we analyse the fuzzy inference module we can obtain the group's opinion concerning the scenarios with a greater possibility of occurrence.
- Selection of sensitive events

Once the scenarios with the greatest possibility of occurrence have been obtained, the common events that make the scenario a good candidate for future materialisation are analysed. These common events are called sensitive events.Drafting of questionnaires. Round 2

- Starting from the sensitive events, new and different questionnaires from those used in the first consultation are made, with combinations of sensitive and other events.
- The Consultation process. Round 2
- Once the questionnaires have been collected, the experts are consulted following the same procedure as for the first round.
- ualitative data processing. Round 2
- Once the deadline for the feedback from the experts has expired, this is processed qualitatively in the same way as for the first round of consultations.
- Confirmation of sensitive events
- Once the scenarios most likely to occur have been identified from the second round, the next step is to analyse the common events offering the greatest pos-

sibility of materialising. These events are then compared with those oobtained from the first round.

Should the majority of these coincide, as is generally the case, the analysts verify and register the list of sensitive forward-looking events, which will provide the basis for the final report on the exercise.

Should they not coincide or if there is a certain discrepancy in the behaviour of the sensitive events, it would be advisable to reconsider their selection for the second round, or if necessary the selection of events from the first round.

Interpolation and validation of opinions on remaining scenarios

On completion of the first and second rounds of expert consultation, a total of thirty out of a possible one hundred and twenty-eight scenarios have been explored. For the validation of the rest of the scenarios (the remaining ninety-eight) a neuronal network based on a multilayer perception is used (Castillo, 2015).

The network learns from the answers provided by the experts to the thirty scenarios. Once the network receives this information, the ICT specialists validate that the withdrawal of the remaining ninety-eight scenarios does not produce any scenario with a higher probability of occurrence than the thirty consulted by the experts.

In the event of any anomaly in the validation, the network can be retrained with a new topology in order to confirm the anomaly. If the anomaly is confirmed, the selection of sensitive events should be reconsidered. At this point, if a validation of the interpolations made by the neural network is needed, the analysts could propose a further round of consultations with the experts to verify that the responses provided by the neural network are endorsed by the group of experts.

Information analysis

With the information generated by the group of ICT specialists regarding the scenarios with the greatest possibility of occurrence, the analysts carry out an in-depth analysis of the individual characteristics of the sensitive events and their effects on the scenario as a whole.

The analysts select one or more characteristic scenarios and specify the appropriate premises for them to materialise, as well as examining the causes that could prevent these scenarios from taking shape in the future.

Analysis of inferences from the environment

Once the main characteristics of the selected scenarios have been analysed, and based on the hypothesis of their future materialisation, the influence and inference of this scenario on the social, political and economic environment is considered. Ac-

cordingly, a comprehensive panoramic picture is obtained of the scenario within its environment.

Drafting the final report

All the studies, analyses and ideas implemented and gathered during the foresight exercise must be reflected in the final documentation. This material is usually generated at three different levels:

- Executive Report: A one-page document, describing the objective of the study and its outcome.
- Informative report: This is the document that will be circulated to all levels. The content of the report must be clear, concrete and justified.
- Technical report: This document presents, in a structured format and in accordance with the steps of the methodology, all the data obtained from the experts and its processing, as well as the ideas generated by the analysts and ICT specialists. TIC.

Proactive actions

Carrying out a foresight exercise is not a simple exercise in forecasting. It implies promoting action involving the implementation of the appropriate measures that will lead to the manager's or governor's consolidation or avoidance of scenarios.

Foresight departments or organisations are responsible for recommending actions and must give their reports the necessary momentum to ensure that their proposals reach the highest level of management.

Qualification of Metric Methodology Application

The last phase of *Silver Lining* includes a form that serves as a check-list to evaluate the rigour with which the foresight process has been followed in order to ensure that it meets quality standards and was carried out in full compliance with the methodology.

The result of the metrics set out in this section provides a fairly approximate idea, for both the foresight department and the manager, of the validity of the contents of the final report of the exercise.

The form presented in this section ends by rating the exercise with a "High", "Medium" or "Low" level of reliability, depending on the weighted values assigned to the activities carried out during the foresight exercise.

Silver lining Methodology Qualification Metric Name of exercise: Date:

Actions Phase 1: Setting objectives. Preparation		
From the stability study, it appears that the system is "Stable"	(*)	0,7
From the stability study, it appears that the system is "Unstable"		0,5
The number of experts is less than 15		0,3
The number of experts is greater than 15, but still a manageable number		0,5
The experts have not been evaluated		0,2
The experts' qualifications are well known.		1,5
The experts' qualifications are moderately well known		0,7
The experts' qualifications are not well known		0,4
The number of events is equal to or less than seven		0,5
The number of events is greater than seven		0,3
Actions Phase 2: Consultation process		
Web technologies have been used for the consultation process		0,5
In round 1 a certain grouping of answers was observed		0,5
In round 1 there was coherence in the individual answers		0,5
The sensitive events were clearly identified in round 1		0,5
In round 2 the sensitive events were corroborated		0,8
Actions Phase 3: Data-processing		
The interpolation of scenarios was carried out successfully		0,5
The interpolation of scenarios has been validated by the experts		0,5
Actions Phase 4: Analysis of inferences		
The information has been analysed		0,25
An analysis of inferences with the environment has been conducted		0,25
A final report has been produced in its three forms		0,25
The final report has been circulated for information		0,25
Proactive actions have been undertaken		0,5
Actions Phase 5: Validation of results		
Follow-up and validation initiatives have been scheduled		0,5
The whole exercise took less than two months		0,7
The whole exercise lasted between two and five months		0,3
Consultation qualification index number		

(*)Mark with an X the action performed during the exercise

Calculate the sum of the numerical factors of the actions carried out

Index number	Exercise qualification
Between 7 and 10	High
Between 4 and 7	Medium
Less than 4	Low

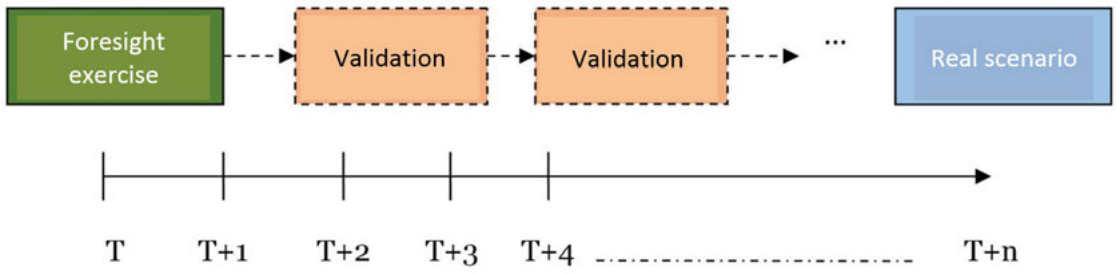
Validation of results

In the past, with the use of traditional methods foresight exercises lasted a long time, sometimes even years. Foresight must be dynamic and cannot be exposed to changes in the initial conditions of the study because of excessive delays in the dura-

tion of the exercise. The average duration of a complex exercise should be less than two months. Depending on the stability of the system under consideration, it should take no longer than five months. The activities that usually have an impact on the length of time spent on an exercise are:

- Specifying the objectives of the foresight study
- Selecting the expert group
- The experts' answers to the questionnaires

Moreover, the coherence between the generated scenario and the real scenario needs to be validated. The scenario-based prospective method is normally proposed within a medium or long-term time frame, for this reason it is necessary to monitor the evolution of the events considered key to the materialisation of the scenario. Should the situation change over time, it is necessary to rethink the problem from a fresh approach that includes the new events that have occurred. For foresight exercises over a ten-year period, it is advisable to carry out a follow-up exercise on the evolution of the scenario every two years or when the events that affect the scenario vary, or when the stability of the system changes.



Comparing "Silver lining" with traditional methodologies

Traditional prospective methodologies are useful today, but the complexity of their mathematical-statistical methods and their rigour make the development of any prospective project difficult to the point of rendering it unfeasible on many occasions.

Information technology usually provides an almost immediate response to any social problem that arises. Mobile technologies, social networks and a long etcetera are a good example of technological response. However, if we try to make a list of the computer solutions that support the process of foresight, we will see that it is practically empty. There are programmes for the implementation of a specific process such as the MICMAC, but it is difficult to find computer applications that support the complex and iterative Delphi method based on probabilities and the cross impact method with its corresponding probabilistic adjustment due to the conditioned probabilities. From the point of view of information technology, the problem of anticipatory forecasting is posed in order to provide a precise solution to a problem that is *subjective* in nature and demonstrates *considerable variability* over time. This is most probably the reason

why the important process of anticipatory forecasting has not been addressed by IT developments to date, together with the fact that the structures of traditional methodologies do not facilitate technological support.

On the other hand, the connectivity provided by the use of the Internet facilitates all kinds of consultations with the experts, regardless of whether they relate to traditional methods or the *Silver lining* methodology.

Silver lining and the incorporation of technologies based on the processing of natural language labels simplify the problem and frame it exactly within the corresponding problem-solving classification: *a multivariable qualitative problem which is dynamic in its evolution, requires a quick solution and permits a certain margin of error that will be adjusted in the validation phase.*

The following table expresses the differential characteristics of the *Silver lining* methodology in comparison with traditional methodologies applied to the scenario-based prospective method.

	Silver lining	Traditional methods
Type of calculation methods	Multi-value logic	Mathematical-statistical
Type of variables	Qualitative (Possibilities)	Quantitative (Probabilities)
Acceptance by the experts	High	Low
Evaluation of experts	Included in the methodology	Not included
Complexity of information processing	Low	High
Influence of group feedback	No influence	average
Resolution for differentiating between scenarios	Medium-High	Low
Analysis of sensitive events	Included in the methodology	Not included
Proactive Actions	Included in the methodology	Not included
Type of final report	Adaptive and pending valuation according to its evolution	Probabilistic. Does not explain validation milestones
Evaluation metrics of the process	Included in the methodology	Not included
Versatility in its application	High	Low
Exercise completion time	2-5 months	1 year or more

Silver lining comparative table

Examples of the application of "Silver lining"

The future of CSDP by the year 2020

At the initiative of the Spanish Institute for Strategic Studies (IEEE.es), a project was launched at the beginning of 2010 to carry out foresight studies in various fields based on the opinions of groups of experts.

The application of conventional prospective methods was a laborious task not without complicated mathematical operations in the field of probability. The expert consultation process was lengthy, as the means of communication did not allow for an immediate response from the expert.

Through this IEEE initiative, the aim was to apply new technologies in the field of strategic planning and more specifically in the field of production and analysis of future scenarios through foresight.

The study was limited to the analysis of the future scenario for the development and implementation of the *Common Security and Defence Policy by the year 2020*[5].

This study applied novel technologies raging from consulting experts online through the Internet, the elaboration of expert opinions through blurred techniques, to the generation of the most possible scenarios based on pattern analysis through neural networks, all of which was guided by the processes established by the *Silver lining* methodology.

The result of the exercise was a convergence of expert opinions towards a clear scenario that could be expressed according to events. As a result, it was concluded that in 2020 "we will face a scenario in which structures will have been streamlined to enhance the planning and implementation of CSDP missions and the CFSP will have been developed in a coherent manner in accordance with the instruments provided for in the Lisbon Treaty".

Qualification metrics in the application of the methodology

The following table calculates the reliability of the result of the exercise (Castillo, 2015)[6].

Silver lining Methodology Qualification Metric Name of exercise: *The future of the CSP in the 2020 timeframe* Date: February-June 2010		
Actions Phase 1: Setting objectives. Preparation		
From the stability study, it appears that the system is "Stable"	X	0,7
From the stability study, it appears that the system is "Unstable"		0,5
The number of experts is less than 15		0,3
The number of experts is greater than 15, but still a manageable number	X	0,5
The experts have not been evaluated		0,2
The experts' qualifications are well known.		1,5
The experts' qualifications are moderately well known		0,7

5 The entire study can be consulted at http://www.ieee.es/Galerias/fichero/docs_analisis/2010/DIEEEA09-2010Estudio_prospectivo_futuroPCSD_UE2020.pdf.

6 Chapter 9 of the book contains a detailed explanation of how *Silver lining* can be used to process expert opinions and obtain group information.

The experts' qualifications are not well known	X	0,4
The number of events is equal to or less than seven	X	0,5
The number of events is greater than seven		0,3
Actions Phase 2: Consultation process		
Web technologies have been used	X	0,5
In round 1 a certain grouping of answers was identified	X	0,5
In round 1 there was coherence in the individual answers	X	0,5
The sensitive events were clearly identified in round 1		0,5
In round 2 the sensitive events were corroborated		0,8
Actions Phase 3: Data-processing		
The interpolation of scenarios has been carried out successfully	X	0,5
The interpolation of scenarios has been validated by the experts		0,5
Actions Phase 4: Analysis of inferences		
The information has been analysed	X	0,25
An analysis of inferences with the environment has been conducted		0,25
A final report has been produced in its three forms	X	0,25
The final report has been circulated for information	X	0,25
Proactive actions have been undertaken		0,5
Actions Phase 5: Validation of results		
Follow-up and validation initiatives have been scheduled	X	0,5
The whole exercise took less than two months		0,7
The whole exercise lasted between two and five months	X	0,3
Consultation qualification index number		5.65

Index number	Exercise qualification
Between 7 & 10	High
Betwen 4 & 7	Medium
Less than 4	Low

Towards a European Armed Force by the year 2020

In 2011, at the initiative of the Spanish Institute of Strategic Studies, a foresight study for the Analysis of a Common European Defence for the year 2020 was proposed.

More specifically, this foresight exercise was called "The EU's Common Security and Defence Policy (CSDP) towards 2020 - Phase II of the Foresight Study"[7].

7 The complete document on the description and conclusions of the exercise is available at http://www.ieee.es/Galerias/fichero/docs_analisis/2011/DIEEEA02_2011EstudioProspectivoSegundaFasePCSD_UE2020.pdf.

The study was carried out during 2011, and was a consequence of the foresight exercise carried out in 2010 and the strategic interest in the subject.

The *Silver lining* methodology permitted the exercise to be developed in a structured, dynamic and timely manner.

The experts' feedback to the questionnaires converged into a clear scenario that can be expressed in terms of events.

Consequently it was concluded that there was a high possibility that by the year 2020 "*The EU would establish a new single civil-military strategic planning structure for CSDP operations and missions, increasing coherence between civil and military issues, as this is the specific added value of the Union; and that the main initiatives underway in the field of military capabilities would be successfully completed, based on the Capability Development Plan (CDP) approved by the EDA in July 2008"* (Castillo, 2015)[8].

Qualification metrics in the application of the methodology

The following table calculates the reliability of the results of the exercise.

Silver lining Methodology Qualification Metric Name of the exercise: The future of the CSP by the year 2020 Date: February-June 2010		
Actions Phase 1: Setting objectives. Preparation		
From the stability study, it appears that the system is "Stable"	X	0,7
From the stability study, it appears that the system is "Unstable"		0,5
The number of experts is less than 15		0,3
The number of experts is greater than 15, but still a manageable number	X	0,5
The experts have not been evaluated	X	0,2
The experts' qualifications are well known.		1,5
The experts' qualifications are moderately well known		0,7
The experts' qualifications are not well known		0,4
The number of events is equal to or less than seven	X	0,5
The number of events is greater than seven		0,3
Actions Phase 2: Consultation process		
Web technologies have been used	X	0,5
In round 1 a certain grouping of answers was identified	X	0,5
In round 1 there was coherence in individual answers	X	0,5
The sensitive events were clearly identified in round 1		0,5
In round 2 the sensitive events were corroborated		0,8
Actions Phase 3: Data-processing		
The interpolation of scenarios has been carried out successfully		0,5

8 Chapter 10 of the book contains a detailed explanation of the application of *Silver lining* for processing expert opinions and obtaining group information.

The interpolation of scenarios has been validated by the experts		0,5
Actions Phase 4: Analysis of inferences		
The information has been analysed	X	0,25
An analysis of inferences with the environment has been conducted		0,25
A final report has been produced in its three forms	X	0,25
The final report has been circulated for information	X	0,25
Proactive actions have been carried out		0,5
Actions Phase 5: Validation of results		
Follow-up and validation initiatives have been scheduled	X	0,5
The whole exercise took less than two months		0,7
The whole exercise lasted between two and five months		0,3
Consultation qualification index number		4.65

Index number	Exercise qualification
Between 7 & 10	High
Between 4 & 7	Medium
Less than 4	Low

Implementation of the "Pooling and sharing" concept by the year 2020

At the beginning of 2013, the Spanish Institute for Strategic Studies undertook a foresight study on European "Pooling and Sharing" in the field of defence, attempting to foresee the European and Spanish scenario by the year 2020[9]. For this purpose, a large group of experts in the various areas related to this field were consulted.

Silver lining was used as a foresight methodology for the study on account of its adaptability and the use of new technologies for the processing of information. The results obtained show that in 2020, with respect to the European scenario, *"it is worth noting the advance of multipolarity from a geopolitical perspective at global level and the slow progress in consolidating a common security and defence policy".*

From a Spanish perspective « *the scenario in which the P&S will develop will be marked by a recovery from the economic crisis, but with a strong commitment to the European initiative. This will possibly favour and encourage this endeavour at national level insofar as the EU considers it to be necessary".*

Although both scenarios (European and Spanish) are not overly optimistic, they leave open a path of hope for the P&S initiative provided that events at political level continue to develop and with the expectation that external threats are

9 The complete study concerning the description and conclusions of the exercise can be found at http://www.ieee.es/Galerias/fichero/docs_investig/DIEEEINV-01_Estudio_Prospectivo_TECNALIA_IEEE.pdf.

not consolidated in the face of a Europe still fragmented in terms of defence and security (Castillo, 2015)[10].

Qualification metrics in the application of the methodology

The following table assesses the reliability of the results of the exercise.

Silver lining Methodology Qualification Metric Name of exercise: The future of the CSP by the year 2020 Date: February-June 2010		
Actions Phase 1: Setting objectives. Preparation		
From the stability study, it appears that the system is "Stable"	X	0,7
From the stability study, it appears that the system is "Unstable"		0,5
The number of experts is less than 15		0,3
The number of experts is greater than 15, but still a manageable number	X	0,5
The experts have not been evaluated		0,2
The experts' qualifications are well known.	X	1,5
The experts' qualifications are moderately well known		0,7
The experts' qualifications are not well known		0,4
The number of events is equal to or less than seven	X	0,5
The number of events is greater than seven		0,3
Actions Phase 2: Consultation process		
Web technologies have been used	X	0,5
In round 1 a certain grouping of answers was identified	X	0,5
In round 1 there was coherence in individual answers	X	0,5
The sensitive events were clearly identified in round 1	X	0,5
In round 2 the sensitive events were corroborated	X	0,8
Actions Phase 3: Data-processing		
The interpolation of scenarios has been carried out successfully	X	0,5
The interpolation of scenarios has been validated by the experts		0,5
Actions Phase 4: Analysis of inferences		
The information has been analysed	X	0,25
An analysis of inferences with the environment has been carried out	X	0,25
A final report has been produced in its three forms	X	0,25
The final report has been circulated for information	X	0,25
Proactive actions have been carried out	X	0,5
Actions Phase 5: Validation of results		
Follow-up and validation initiatives have been scheduled	X	0,5
The whole exercise took less than two months		0,7
The whole exercise lasted between two and five months	X	0,3
Consultation qualification index number		8.8
Index number	Exercise qualification	

10 Chapter 11 of the book contains a detailed explanation of the how *Silver lining* can be used in processing expert opinions and obtaining group information.

Between 7 & 10	High		
Between 4 & 7	Medium		
Less than 4	Low		

Overview of the methodology

The interest of human groups in the future is reflected in Foresight as one of its tools, and thus awakens great interest in Sociology. The social sciences cover all relevant aspects of other sciences whose repercussions on social reality have a certain relevance.

The application of *Silver lining* can be summarised in five clearly differentiated Phases:

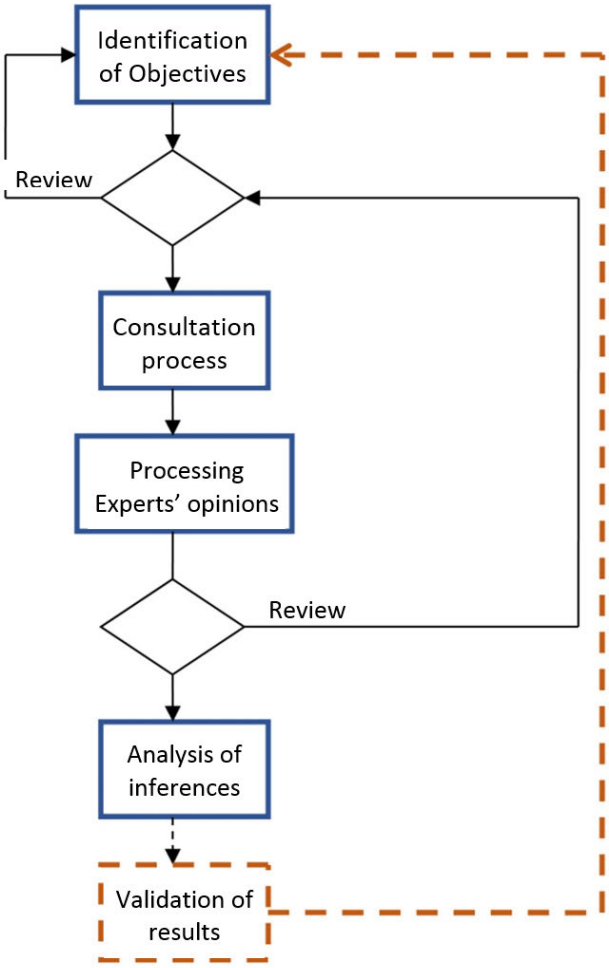
- Setting objectives. Preparation and previous processes
- Consultation process
- Processing of expert opinions
- Analysis of inferences
- Validation of results

By setting objectives, the aims of the prospective study are defined and preparatory processes such as the selection of the time frame, the events that can be part of the scenario and the selection of the experts are established. This activity can be recursive, since at its conclusion some of the objectives of the study can be reconsidered.

Once consultations with the group of experts have been concluded, the information is processed using new technologies. The resulting information and its inferences are then analysed or it can give rise to a new approach in relation to the consultations because some anomaly has been detected in the process.

Finally, the validation phase is carried out, which consists of corroborating how the planned scenario materialises over time. In the event of new events occurring that could impact on the scenario, an analysis of these events is conducted and the need to conduct a new study is reassessed, as required.

These five phases can be demonstrated in an execution model in the following flow chart.



Synthesis of the Silver lining flow chart

Analysis of results

It is worth highlighting that the consolidation process of the *Silver lining* methodology has followed an iterative cycle during its almost five years of research. Following a pattern of continuous improvement, the phases have been refined and perfected throughout the entire process of their creation and validation.

The main difficulty facing the research has been the scarcity of reference scientific literature relating to the latest publications in anticipatory forecasting. Most centres carrying out foresight studies either rely on a hermeneutical approach or technical forecasting. This corroborates the hypothesis that current methodologies and their associated procedures are not dynamic and do not respond to present-day needs, and therefore their use is abandoned.

One of the advantages that has facilitated the development and application of the research has been the opportunity to collaborate with centres involved in foresight studies, such as the Spanish Institute of Strategic Studies and the ISCRAM group from the New Jersey Institute of Technology.

After analysing the results obtained from real cases, the time required to carry out foresight exercises has been shortened in all of them and a high degree of satisfaction

obtained from the groups of experts, the analysts and the recipients of the final reports. In all exercises, the structure of the methodology, the experts' level of knowledge and the metrics used to evaluate the level of quality of the exercise have been described as very useful.

Future work

Based on the objectives achieved with the application of *Silver lining* and an analysis of the processes involved, new research work could be carried out in the future that would allow us to continue innovating.

Below is a list of some of the tasks that need to be addressed:

- Convergence of technical and anticipatory forecasting: this convergence would help to assess the future with greater precision, since on many occasions some of the variables that make up the scenarios can be affected by marked trends in their evolution over time.
- Promoting the development of support tools: information technologies, and specifically the development of computer applications, will make it possible to standardise and consolidate the use of procedures.
- Expert validation: the success of anticipatory forecasting will be greater to the extent that the experts are truly knowledgeable in the field and have a high level of social intelligence. The types of tests affecting two particular areas need to be explored and studied in greater depth: a generic test to establish links between events and a specific test for the particular field in which experience is required.
- Integration with social networks: social networks are a very useful tool for obtaining information. There is no doubt that the integration of social networks in the process of consulting experts would speed up the feedback while allowing the number of experts to be increased, and perhaps facilitating their selection.
- New solutions to restrict the number of events: *Silver lining* offers the solution of cascading scenarios for the design of exercises based on sensitive events. Although this solution is viable and effective within the process, it may not be the most suitable option. For this reason, it appears necessary to open a new line of investigation that easily allows the management of scenarios with a greater number of events.

Conclusions

Having achieved the objectives that gave rise to the initiative to obtain a Spanish methodology for carrying out foresigth exercises in support of strategic planning, in conclusion its contributions can be grouped into three main areas:

- From a methodological perspective

  Silver lining is an adaptable, well-structured methodology that can be applied to any area where prospective scenario analysis is required for the benefit of strategic planning. In addition, it incorporates a metric that allows for the evaluation of the quality of the foresight exercises carried out.

- From a technical perspective

  Nowadays there are technologies that can replace the mathematical-statistical methods that have been used until now. These technologies, based on the processing of natural language adjectives, have a better acceptance among participants in foresight exercises and provide a more realistic solution

- From a strategic planning perspective

  Strategic planning usually relates to the long term, but there may be decisions of a strategic nature to be made in the medium or short term. For this reason, new solutions are needed that are adapted to technological development and provide answers in a short period of time. Such is the case of the technological contribution and reduction in runtime provided by *Silver lining*. On the other hand, the application of strategic planning is not limited exclusively to organisations or companies, but is present in all areas where social sciences are used.

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