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RISK MANAGEMENT IN AGILE ENVIRONMENTS.

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There are few references on how to perform risk management in agile environments or projects. There is even some internal debate in these types of projects about whether risk management is intrinsic to agile management. If the high degree of uncertainty that this type of project has is considered and that risks are associated with it, risk management should be present in agile project management. The approach to this type of management has points in common with predictive management, but it also has differences to be taken into account. In addition, the document shows some tools used in real agile management projects.

Keywords: risk management; agile; project management; risks.

GESTIÓN DE RIESGOS EN ENTORNOS ÁGILES.

Existen pocas referencias sobre como realizar la gestión de riesgos en entornos o proyectos ágiles. Incluso existe cierto debate interno en este tipo de proyectos, sobre si la gestión de los riesgos es intrínseca a la gestión ágil. Si se tiene en cuenta el alto grado de incertidumbre que este tipo de proyectos tiene y que los riesgos se asocian a ésta, la gestión de riesgos debe estar presente en la gestión ágil de proyectos. El enfoque de este tipo de gestión tiene puntos en común con la gestión predictiva, pero también tiene diferencias que tener en cuenta. Además, el documento muestra algunas herramientas utilizadas en proyectos reales de gestión ágil.

Palabras claves: gestión de riesgos; gestión ágil; gestión de proyectos; riesgos.

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1 Introduction

Risks and projects walk together, whatever the methodology or framework we consider. By the very conception of a project, every project has risks associated with it. If it does not, it is not a project. Moreover, considering also the dynamic environment that usually surrounds projects, risk management is necessary.

According to the Manifesto for Agile Software Development, value is one of the key points (Beck et al., 2001) and, in this sense risks become in fact in anti-value factors.

Everybody remembers the well-known sentence "*Uh, Houston, we've had a problem*", pronounced by Jack Swigert in the mission Apollo XIII. Risk management, even in agile projects, tries to anticipate and cope with so that risks do not materialise into problems.

Awareness of why managing risks is an important aspect to consider in agile projects. Whether risks are managed or not, they are inherent to the project and not wanting to see them is not a very constructive attitude for the success of the project. The reasons that justify risk management and the cases that have served as justification for not doing so up to now are analysed. Many aspects of risk management in traditional projects are valid in agile projects.

Before continuing, it is relevant to highlight the scarcity of literature related to risk management in the field of agile projects. Two main references should be considered: "Waltzing with Bears: Managing risk on software projects" (Demarco et al., 2003) and "Agile Risk Management" (Moran, 2014).

2 Differences in Agile Environments

2.1 Risk Management in Agile Projects

Concerning project risks, there are two basic options: ignore them or manage them. According to authors such as Steve Mc Connell (2002) and Eliyahu M. Goldratt (1997), the main reasons, why agile projects fail, considered are:

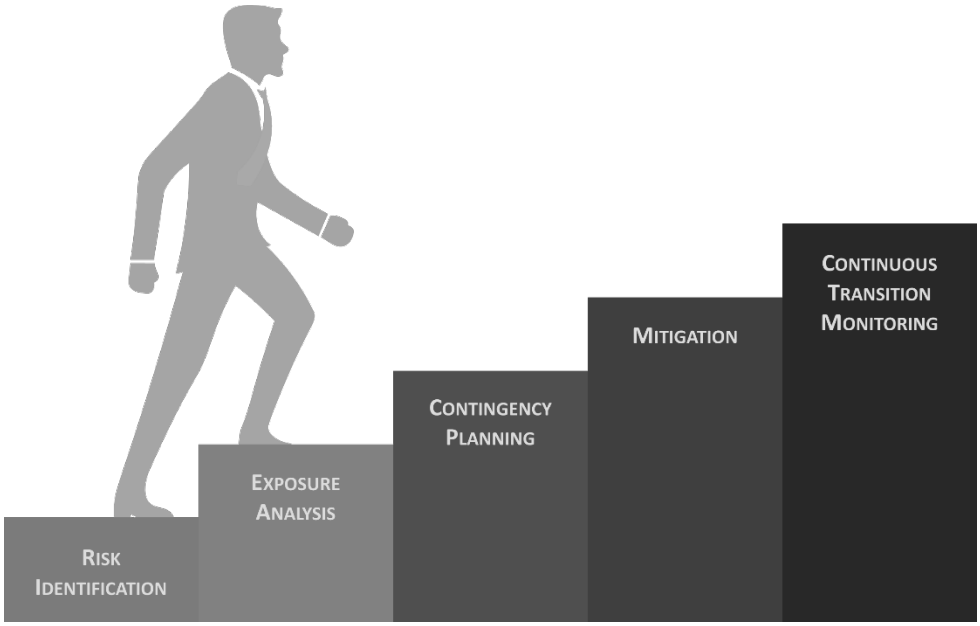
- Expansion of functionality.
- Poorly defined requirements.
- Gold plating.
- Ignore testing.
- Optimistic calendars.
- Multi-tasking or "multi-projects".
- Poor design.
- Syndrome "the same solution always works".
- Lack of qualification.

Tom Demarco (2003) considers risk management to be project management for adults. The reasoning is simple, not managing risks is a childish attitude. A child does not measure risks when playing or doing anything. Their parents or guardians (adults) are responsible for the risks that may occur and their management.

The main steps to be implemented in risk management within an agile framework are shown in Figure 1. They follow the same schema that in a predictive approach. This management should be introduced as part of agile project management. This implies that it affects the collaborative and cooperative work of the team and should be considered as another point in

the different meetings and iterations. Besides, a working system should be considered that contemplates the use of agile tools for its management, both in the identification, analysis, planning and monitoring. The analysis scope includes in this framework, firstly the global scope of the whole project, and then the functionalities and tasks considered in each iteration.

Figure 1: Key activities in agile risk management.



2.2 Why Manage Risks?

To approach a situation that answers the question of why manage risk and deepening of the analysed literature, several points should be considered. For example, if the risks of the project are made clear, the client may be frightened. But showing a work plan to manage them allows informed decisions to be made. Another point is that risk management allows "thinking in the negative", i.e., to focus on scenarios in which the project may fail. Risk management makes it possible to distinguish between demanding objectives and reasonable expectations.

Failure to meet objectives affects the motivation of teams. Too often, we see "failed" projects where there is good reason to believe that those responsible are capable and that their team is competent to do the work they have been asked to do.

When project after a project fails, this means that the problem comes from the project set-up and therefore risk management breaks this negative cycle and should give a framework for action to define achievable objectives that will generate a successful project.

Another aspect to bear in mind is that if uncertainty is known, the necessary reserve can be calculated to protect the success of the project. The reserve includes the cost necessary for risk mitigation, but also extra to cover the "unexpected". The cost of a risk materialising is higher than the expected reserve. Uncertainty, the "fear of failure" limits projects, conditioning their proper progress. Risks exist and their management enables informed and intelligent decision-making.

Not wanting to see risks does not mean that they will not occur. If the option of not wanting to see the risks is introduced into the culture of the organisation, this is transferred to the people in the organisation itself and their professional development. The most competent employees do not want their projects to fail and will not feel part of an organisation with this corporate culture. Risk management will not prevent problems from occurring, but it will allow them to be

faced with a more favourable perspective. Almost every problem is preceded by a warning, which could be known.

Risk management allows attention to be focused where it is needed. The opposite would be a management of recklessness, management of problems. It is about turning a defensive attitude into a proactive one. A winning strategy seeks out and seizes opportunities and avoids and mitigates risks that could cause it to fail. When luck becomes an integral part of the strategy, projects are in trouble.

As a general rule, some cases could be considered where risks do not have to be managed, such as:

- Very low probability of materialisation.
- The materialisation of the risk is an irrelevant effort.
- Nothing can be done to prevent it.

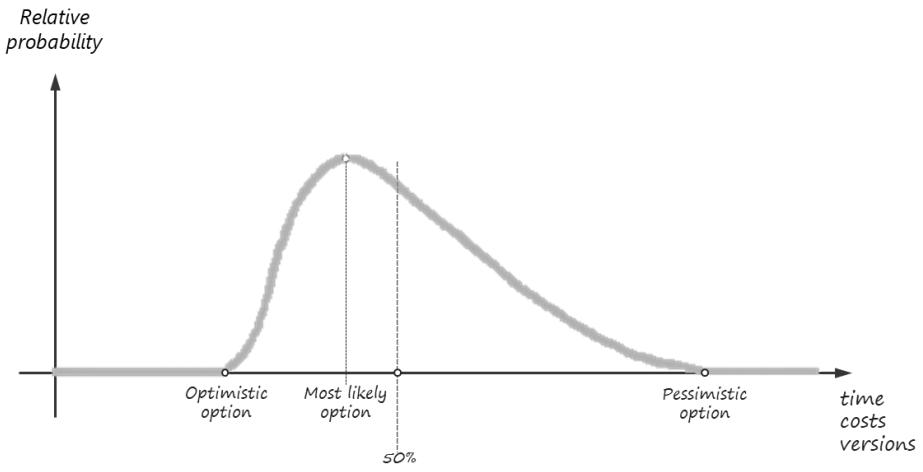
It is important to consider that usually limiting the extent of losses in agile projects is more important than acting concerning the potential benefits that can be achieved.

2.3 Uncertainty in Agile Projects

In agile environments, the range of uncertainty is usually very wide. In predictive approaches, experts talk about a range between 2% and 5%, but in agile environments, the uncertainty range is much wider. In this sort of project, it is not an exceptional occurrence to work with a level of uncertainty of more than 200%. In risk management theory, the uncertainty associated with the project is very high; but in the experience of previous projects, it is known that it is not so high. The key is the imprecision of estimates that can lead to error.

To facilitate this point, a curve representing uncertainty will be developed, called an uncertainty diagram or risk diagram (see Figure 2). The ordinate axis represents the relative probability, while the abscissa axis represents the aspect in which the uncertainty is being quantified: time, cost, effort, etc.

Figure 2: Uncertainty diagram.



The uncertainty of any project usually follows the pattern discussed above. This diagram usually reflects a larger window than a project manager expects, even much larger. If applied to delivery times, the most optimistic date it reflects is usually much later than the team would have thought, even in many cases committed to the client. The definition of the three key data for the elaboration of the curve is key and should be as accurate as possible. Otherwise, the information it could provide us with for decision-making is meaningless. The identification of

these points must be based on the opinion of experts in similar projects. The use of risk diagrams allows the team to focus on the probability or improbability of a committed date, cost, effort, version, etc. Explicitly stated uncertainty justifies decision-making in risk situations.

The most common pattern for representing uncertainty is as seen before. First, this a model that follows a beta distribution. Furthermore, it is a curve in which the probability is skewed to the left. If we talk about lead times, the probability of earlier delivery would be higher than later delivery. The "tail" of the curve becomes longer. If we talk about the cost of the project, the curve represents that it would be more likely to be executed with tighter costs.

3 Mechanics and Dynamics of Agile Risk Management

3.1 Mechanics of Agile Risk Management

Following the key activities for the risk management described in the section “Risk Management in Agile Projects”, the first step is risk identification. The corporate culture generally does not facilitate risk identification. Good practice in agile is to have a risk repository developed. There are also many other ways to identify the risks that exist in a project. In this sort of environments, in addition to the usual ones, component analysis is an option to consider.

In this research, a special case of brainstorming was applied for this sort of projects. This is the catastrophic brainstorming and proposes reflecting these questions:

- What are the worst fears you can think of that could happen in the project?
- If we had a crystal ball and could see into the future, do you see any disasters? How did they happen?
- Change of perspective - what would be the best thing that could happen to us in the project? Reverse the situation.
- How could the project fail without it being someone's fault?
- How could the project fail miserably because of us? and because of the lack of management? and because of the users? and because of you?
- We have completed the project, but we know that some stakeholder is upset with the result - what happened?

Without going into detail on the risk exposure assessment, which considers the likelihood and impact of each of the aspects identified, the next point to take into account is the development of a risk strategy. For agile, as well as for predictive projects the possible strategies are the same and are shown in the next table.

Table 1: Risk management strategies.

Negative risks	Positive risks
Risk avoidance Risk containment or mitigation Risk transfer	Risk exploitation Risk sharing Risk enhancement
Risk acceptance	

The strategy of accepting risk can be passive or active. Passive acceptance requires no action on the part of the project team; whereas active acceptance involves the establishment of contingency plans. Contingency plans involve additional cost, time and effort to be incorporated into the project.

Risk mitigation involves effort, cost and time, and unlike risk materialisation, it is a sure payoff. If no mitigation action is taken concerning risk and then the risk does not materialise, there would be no implication.

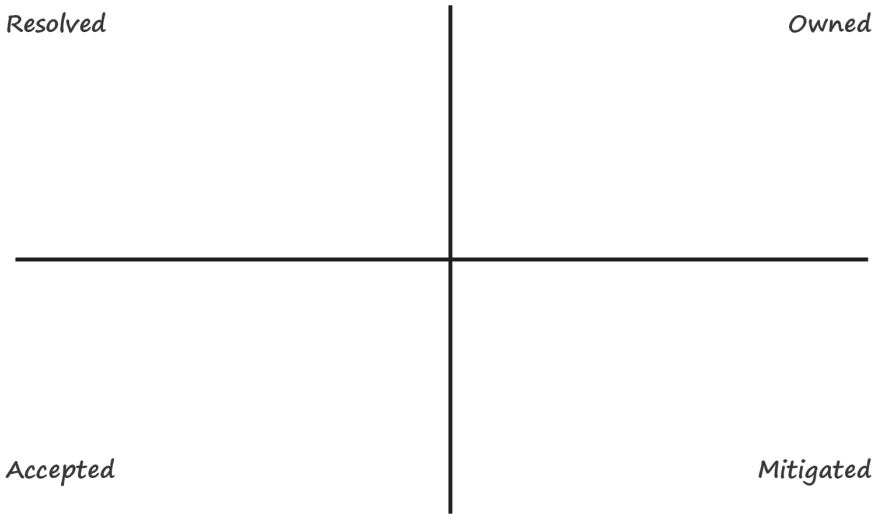
In a much more practical approach, the meetings that occur in each iteration are a good time to identify or analyse risks and to notify and identify possible alerts or to monitor them.

As previously mentioned, risk management should be integrated naturally and automatically into the mechanics of project management. Just as feature and functionality requirements are established in an iteration, risk responses can also be identified.

A typical tool related to agile risk management is the ROAM board, as is shown in Figure 3. This is a simple tool to work on risks. Its name comes from the acronym of the words that define the different options:

- Resolved: the risk no longer exists.
- Owned: waiting for further action, implies the assignment of a responsible person.
- Accepted: No action is taken about the risk.
- Mitigated: Involves action to mitigate the risk.

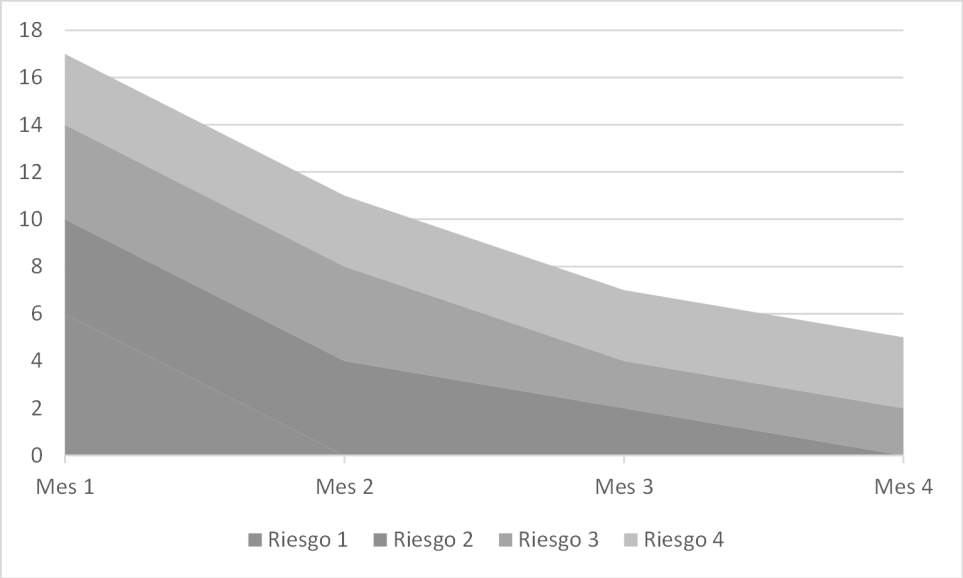
Figure 3: ROAM board.



In a risk analysis, the risk exposure can be monitored. If the analysis is correct, the risk can be eliminated. A tool that can be useful is the "burn-down" diagram of risks. This tool tracks the exposure of different risks over time. An example of this tool is shown in the next figure.

Figure 4: Risk burndown diagram.

	Month 1			Month 2			Month 3			Month 4		
	Imp.	Prob.	Exp.	Imp.	Prob.	Exp.	Imp.	Prob.	Exp.	Imp.	Prob.	Exp.
Risk 1	3	2	6	3	0	0	3	0	0	3	0	0
Risk 2	2	2	4	2	2	4	2	1	2	2	0	0
Risk 3	2	2	4	2	2	4	2	1	2	2	1	2
Risk 4	3	1	3	3	1	3	3	1	3	3	1	3
			17			11			7			5



Finally, from an agile point of view, it is recommended that a retrospective review of risk management be carried out.

A simple questionnaire to think about:

1. Are risks being eliminated or reduced?
2. How is the remaining risk being "burned off"?
3. What is the rate of risk reduction per iteration?
4. When will the exposure to the remaining risk be zero?
5. Are there any new or increasing risks?
6. What are the root causes of the risks, and can we eliminate any of them?
7. Which risk avoidance or risk elimination strategies are working and which are not?
8. In the case of risks that are decided to be transferred, how are they managed by third parties, what can be learned from them, or would it be better to bring them back in-house?
9. How are the risk management skills of the team being developed?
10. Where is mentoring and/or support needed?

3.2 Dynamics of Agile Risk Management

Risk management requires continuous activity, which entails:

1. Continuous monitoring of transition indicators.
2. Continuous identification of risks.
3. Gathering data to feed the risk repository, which allows us to know the impact of risks or windows of uncertainty from past projects.
4. Daily monitoring of closure metrics.

Closure metrics are an indication of the status of project execution. There is no perfect metric, typically they are used:

- Closure of boundary items.
- Earned value performance (EVR).

In the first case, projects start from a set of inputs that are transformed into outputs. The boundaries of the outputs may be defined, but not designed. The idea of metrics involves breaking down each of the elements into packages to know what has been executed and what has not.

In the case of the second, earned value execution, the metric would be a consequence of passing the acceptance test. The key depends on the construction of an incremental system. By establishing a series of versions of the result and how incremental each version is, we can track closure.

3.3 Integration of Increments

Starting from incremental management in project development, each delivery should include the results of the previous one plus several additional functionalities.

The complete strategy for incremental execution can and should be thought out and described in an incremental delivery plan. This approach generates some advantages such as:

- Confirmation or rectification of project assumptions.
- Prioritisation of components or functionalities.

Possible optimisation of the benefits of each increment.

- Feedback on development.
- Facilitates cancellation of the project, if necessary.

The generation of increments in the development of the project should be a consequence of prior planning and not the responsibility of the programmers during the project execution process. So the selection of criteria should be based on:

- Value delivered to stakeholders.
- Confirmation of risk-related assumptions.

The process to be followed is as follows:

1. The version is identified by the subset identified in one of the elements.
2. The tasks associated with that version are those whose realisation is demonstrated by the acceptance of the version.
3. The version acceptance test for each version is the set of criteria that must be met to declare the version complete.

4 Risk Valuation

4.1 Quantification of the value

Before proceeding further, it is useful to distinguish between two types of risks:

- Aggregate risks: these are the risk profile of entire projects, expressing their uncertainty in delivery dates, total cost, versions.
- Causal or component risks: such as staff production rate or staff turnover.

The two are related. Uncertainty about an aggregate outcome is a direct issue of the causal factors leading to project success or failure. The process of identifying the aggregate risk from the causal risks is called risk modelling.

There are cases where it is very straightforward and simple to quantify the value of the project (and the risks) and it would be sufficient to know the return on investment. But the circumstances of today's projects are more complex, e.g., to improve market position, to be competitive, etc. Situations where the quantification of the benefit is much more complicated. However, costs and benefits should be specified with the same precision. These benefits can be expressed numerically in terms of market penetration, revenues, profits, repeat business,...

The risks that have been considered so far were linked to the product, usually technological risks, or to the project itself, more sociological risks. Here we are talking about value-related risks, which affect the company's decisions. Value involves wasted effort on low-value projects and the opportunity cost of losing high-value projects.

As has been the case so far, there is uncertainty in the profit. An optimistic, more likely and pessimistic expectation of the expected benefit can be formulated.

The calculation of the benefit can be obtained by following these steps:

1. Each stakeholder states the expected benefits, just as the developers state the expected costs and timescales.
2. Similarly, the stakeholders declare the uncertainty in their expectations in parallel with the declaration of the uncertainty in the costs and timescales by the developers.
3. Stakeholders assess the relative value of system components to have a basis for selecting different versions and to perform a sensitivity analysis and an incremental cost-benefit analysis.
4. Management justifies the project based on full information on costs, benefits and uncertainties.
5. Finally, the management evaluates the benefits obtained ex-post.

4.2 Sensitivity Analysis

The starting point for the sensitivity analysis will be the incrementalism in value accounting, which comes from the different stakeholders.

Knowing the value of each stakeholder, the following questions are posed for first sensitivity analysis:

- Where is the value of the product?
- Is it evenly distributed across all components of the system?

In all likelihood, the value is very unevenly distributed. Moreover, in some cases, you might find that the value is concentrated in... 10% of the product. So the question is, what is the rest of it for, is it needed or not?

In the LEAN philosophy, there are three types of activities or tasks in any process. This concept, could be applied in this analysis and they would be:

- Components that add value to the system.
- Components that do not add value, but are necessary for the system.
- Components without value and unnecessary, which could be eliminated.

Once the different components have been identified, it seems normal to assign the estimated cost of each package to each item. But also, the value expected by the different stakeholders should be distributed on the map.

With this knowledge, the value - cost ratio of each component could be calculated. In this way, it would be possible to identify those components with a high ratio and which would be the first to be implemented. But equally, it may be discovered at any stage of implementation that the average value-to-cost ratio of unimplemented functionality may below. In this case, logic might dictate that the project should not proceed.

Eliminating those parts of the system where the value-to-cost ratio is low would be the easiest and most convenient way to relax time and cost constraints and eliminate uncertainty and risk associated with the project.

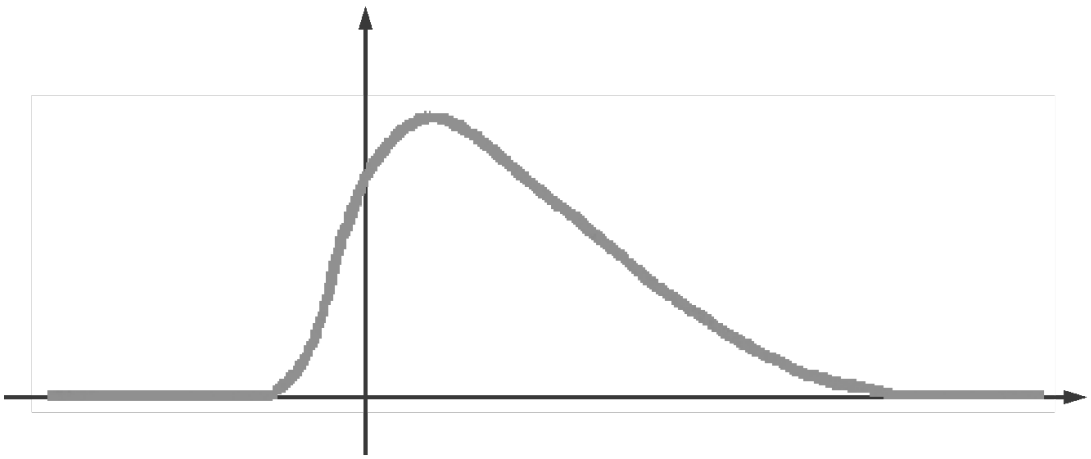
It should be noted that this situation becomes almost utopian in most projects, due to the lack of consensus and/or information from stakeholders on the various components of the project. However, from the perspective of the project team, it should try to make it a reality.

4.3 Compensation Value

How much risk should you be willing to take on a given project? Whatever the answer, it must take into account the potential value that the project can bring. No viable risk-taking philosophy can ignore the value. When the stakes are high, any risk is worth taking, even serious risks. When the value is low, almost no risk should be tolerable.

In agile projects, however, it seems that the philosophy is almost the opposite. In many cases, the expected value is unknown, not quantified. Moreover, for example, in projects with very tight deadlines, which require total dedication of key resources, sacrificing personal aspects of the team members, we may find that if this analysis had been done, it may be that the result would be a low expected value. The real justification of the project requires a balance between risk and value. The problem is that both are justified on a basis of uncertainty. Ideally, it would be possible to make a joint analysis, the result of which would allow the net benefit, the difference between value and cost, to be known (see Figure 5).

Figure 5: Compensation Value



5 Conclusions

Following the aspects discussed above, the basis of risk management in agile environments is the same as risk management in traditional approaches.

A starting point to highlight is the resistance or conscious ignorance that agile teams have to risk management.

The agile management introduced in risk management generates a quantum leap from the mechanics of management to the possibility of integrating it with dynamic management at each iteration.

This research is progressing with the use of practical tools such as visual risk management dashboards, decision trees and the use of Montecarlo simulation.

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