Innovation as a Solution to an Airline's Operations Crisis

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***Abstract*--In this paper, we distinguish "crisis management" from "disaster management". We employ "disaster management" when human lives are lost. "Crisis management" refers to the solution of an operations crisis without lost lives. Our empirical illustration will be a 2010 Brazilian Airline operational crisis, which had its origin in the crew schedule planning, analyzed through the extended case method. We have found that a very proactive "disaster management" does not imply even a mild reactive "crisis management". We have also found that the solution of a crisis may lead to many good ideas and operational progress. To avoid new operational crisis, the company adopted process improvements and created a dedicated permanent group, a new administrative structure.**

I. INTRODUCTION

The year of 2010 was both critical and chaotic for AIR1 (a disguised name for the airline depicted here). Without any apparent reason, the aircrafts were grounded and the direct visible effect was a delay on all flight operations that gradually increased day by day until an operational collapse in the end of November 2010. As a consequence, ANAC (the Brazilian aviation authority) issued a 5 days ticket sale prohibition.

A small intern consultant team was created specifically to investigate, control and solve the crisis. Beyond the delays and the grounded aircrafts (the visible part of the crisis), this team found a complex structure that leaded to this scenario. Here we call this team AR (disguised name). After one year of a complex and puzzling project, a new emerging flight operation had been born.

The lack of available literature about crisis management is clear [3][13]. This represents a big research opportunity in an area that used to be remembered only when a problem emerged. Probably due to the lack of publications, there is little knowledge, ambiguous definitions and tentative conclusions. There are some studies in crises management regarding Finance and Public Relations, but very little in Operations Management. Roux-Dufort [13] states:

> *[…] They suggest that organizations should learn from crises, but they rarely uncover the extent to which organizations learn, what they learn and under what circumstances they learn. Even more striking is the fact that very few works have been published to determine exactly what a post-crisis learning process is. This, despite the fact that a field of crisis management has been developed, accompanied by a burgeoning literature [...]*

For instance, "Disaster Management" is sometimes seen as synonymous to "Crisis Management", what leads to a confusion. For instance, Ritchie [12] used "Crisis management" as a synonymous of "Disaster management" in the tourism industry. In the context of an airline disaster, Pinsdorf [9] presents "crisis" linked to communication. Ramsay [10] uses "crisis management" as a tool to demonstrate the safety of emergency plans in accident hazards (maybe it would be closer to "disaster management"). The consumer response to harmful products is the context used by Vassilikopoulou, et al. [14] to analyze crisis management. Even responses to events like 9/11 attacks and Katrina are used in a way to illustrate the term "crisis management" [11].

As can be seen, there is some ambiguity and confusion on the definition of "crisis management" and "disaster management". The definition presented by Lin, Zhao and Ismail (2006) to the words "crisis" and "disaster" help us in the concept development of "crisis management" and "disaster management":

> *We differentiate a crisis from a disaster, defining a crisis as a critical and stressful condition that can be triggered by human errors or technology malfunctions internally, or extreme and surprise factors externally (Hermann 1963), while defining a disaster as a severe negative consequence resulting from the failure to properly handle a crisis.*

As shown before, in some studies "disasters" have been associated to events not linked to a previous crisis, like Katrina or the 7/11 air strikes. In the field of operations management, the closest to a definition that we can find was enounced by Burnett [2]: "crisis is 'a disruption that physically affects a system as a whole and threatens it is basic assumptions, it's subjective sense of self, it's existential core'". Mitroff, Shrivastava and Udwaldia [8] state that "Corporate crises are disasters precipitated by people, organizational structures, economics, and/or technology that cause extensive damage to human life and natural and social environments".

All above definitions considered, we will restrict the term "crisis management" to the management of a disruption caused by people, technological systems, politics or economics, jointly or in isolation, and lead an organization to a negative impact and even to paralyze its core operations without loss of human lives. On the other hand "disaster management" will be treated as the management of consequences of a big event caused by nature, industry, accident, terrorism or even a no solved crisis that evolve, where there is loss of human lives.

In this article, after a brief review about the project developed in the AIR1 crisis's context, we will analyze the emerging flight operation to verify if it has a better crisis avoidance capability. This lead us to the proposed research question. May an operational crisis changes a company's Crisis Management orientation from reactive to pro-active, adapting the Disaster Management orientation?

Mittroff, Shrivastava and Udwadia [8] propose that a company can be crisis reactive oriented or crisis preventive oriented and this distinction leads to a fundamental paradox:

> *The less vulnerable an organization thinks it is, the fewer crises it prepares for; as a result, the more vulnerable it becomes. Conversely, the more vulnerable an organization think it is, the more crises it prepares for; as a result, the less vulnerable it is likely to be.*

Figure 1 can help the understanding of this paradox.

As there are no mentions about differences between disasters and crisis in this model, we can assume that it can be applied to both. In an airline context, the worst possible scenario is disaster management: an aircraft crash or some kind of accident with lost or threatened human' lives. For these big disaster scenarios, there is a very well designed system of prescriptions. With well established management and operations processes and procedures, which put senior management in a crises room and starts a complex disaster control process. From this perspective, an airline can be considered a disaster preventive oriented organization. As we will see, despite this sophisticate "disaster management system", when there is no threat of losing lives we cannot assume a pro-active orientation for an airline's "crisis management". The response profile may be entirely reactive and slow!

II. METHODOLOGY

At first, we did some in-depth interviews with the project team (one senior manager, one senior analyst and two analysts), to understand AIR 1 crisis' context, the response project and the process developed. We also interviewed a former consultant from a management consulting company that was developing some projects in the context of AIR 1 operations crisis.

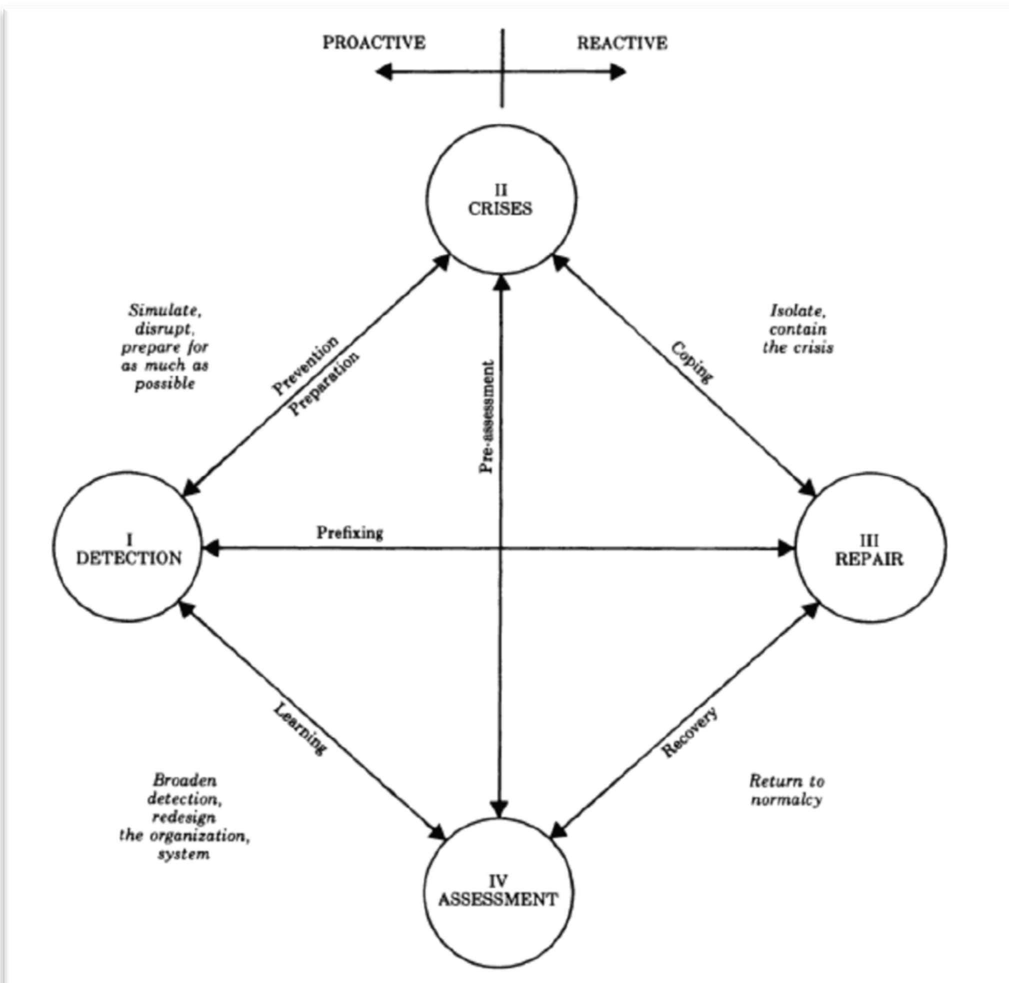

Figure 1: A Model of Crisis Management (Mittroff, Shrivastava and Udwadia, [8])

Due to the lack of theory in the literature, we applied the extended case method to explore and understand the company's management response to the operations crisis. When theory is not fully developed, the extended case method helps the researcher to extend or partially remake it to explain the relevant phenomena.

At first the use of in-depth interviews can be justified by the lack of control over the phenomenon under study [15]. From this point of view, Eisenhardt [4] tell us:

> *Theory developed from case study research is likely to have important strengths like novelty, testability, and empirical validity, which arise from the intimate linkage with empirical evidence. Second, given the strengths of this theory-building approach and its independence from prior literature or past empirical observation, it is particularly well-suited to new research areas or research areas for which existing theory seems inadequate.*

In the same vein, Leonard-Barton [6] argues that:

> *A case study is a history of a past or current phenomenon, drawn from multiple sources of evidence. It can include data from direct observation and systematic interviewing as well as from public and private archives. In fact, any fact relevant to the stream of events describing the phenomenon is a potential datum in a case study, since context is important […]*

As the research progressed, the lack of available literature about Crisis Management [3][13] became more clear. As Mitroff, Shrivastava and Udwadia's [8] state, "the negative effects of organizational and industrial activities have been treated as minor "externalities" of production". Overall, the use of an extended case method was defined as a complementary approach as suggested by Burawoy [1]:

> *The extended case method applies reflexive science to ethnography in order to extract the general from the unique, to move from the "micro" to the "macro", and to connect the present to the past in anticipation of the future, all by building on preexisting theory.*

The extended case method extends four points: Extends the Observer to the Participant, Extends Observations over Space and Time, Extends Out from Process to Forces and Extends Theory. So, as a way to create a feeling about the work done, the process developed in the project as well as the used tools were experienced, project documents were analyzed and places involved in the project were visited.

In conclusion, due to the emergence of the crisis inside the organization as well as the lack of knowledge in Crises Management in the field of Operations Management, the use of a case study supported by an extended case method seemed to be appropriate.

III. THE AIRLINE CASE STUDY OVERVIEW

A few months before the crisis, everything seemed to be well at AIR1. While all senior management were discussing company's strategy, things were happening a little bit differently in operations. Month after month, the problems to generate the next month's crew schedule were increasing. The automated system that should run the crew database and generate the crew schedule was quite inoperative, and the handwork[1] to generate the crew schedule was gradually increasing.

The crew schedule generation became very troubled by the end of 2010 and beginning of 2011. This lead to a chaotic scenario by the end of 2010, completely unexpected by senior management (even less in the end of the year, a period when traditionally there are more flights). When the bad news about the delays began to appear on the journals, magazines and internet, it was too late for AIR1 to avoid the crisis. The main problem then was how to treat the problem as the crisis was not expected and it just emerged (the reasons for the delay in operations were unknown).

A structured process of decomposition of the main problem in possible sub-problems was used in accordance with the conclusion of Loch, Solt and Bailey [7]. After some analysis about the possible sub-problems and many meetings, four main problems were identified at first:

1. The lack of the maintenance of the schedule system.
2. The lack of a methodology to control the crews' career development by aircraft model
3. The lack of a methodology to control the amount of crew required to operate a month flight mesh[2].
4. The poor crew database maintenance.

With big flight delays and a great number of canceled flights[3], the recently assembled team had a hard work to develop solutions in a short timeframe. With four sub-problems identified, three projects began in parallel (due to the approach based on methodology development, the attack on sub-problems 2 and 3 came under the project called "Crew productive capacity"), with a fourth one coming a bit later.

A schematic view of the project development can be seen in Figure 2:

[1] Ideally, the system should generate the crew schedule automatically, but, in the real world, if the system works well, the software allocation routine automatically generates a great part of the schedule, leaving only the fine adjustment to be made by hand.

[2] Fight mesh refers to the total aircrafts routes, ie, every time an aircraft take off and land, a route is traveled and the total of aircrafts routes represents the mesh.

[3] A canceled flight is just a trick to control the published in delay indicator. Once the flight is canceled, it is not included on the indicator, making the index seems better than in reality.

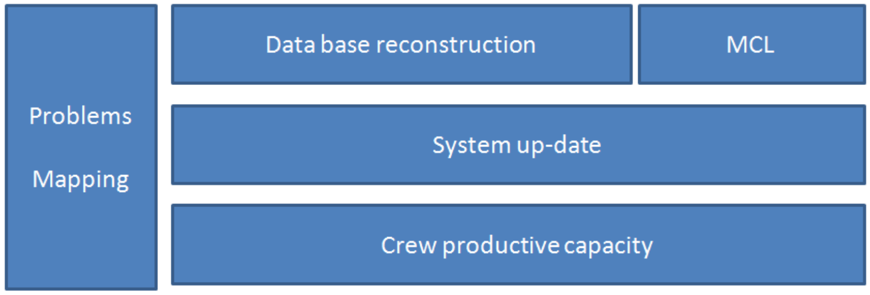

Figure 2: Project schematic view
MCL is the Master Crew List

The fast increase in flight operations (the flight mesh had more than doubled in two years) allied to the lack of maintenance of the schedule system and database lead to the chaos scenario as the system applied wrong data to generate the schedule. The wrong data created a false crew availability number as well as created problems in the control of crew flight hours[4] [5].

Due to the scenario found at AIR1, special help was requested to the software supplier, as a way to help in the system fixing process and to avoid worsening the scenario (project 1): one senior consultant came to Brazil from England, another from United States and a programmer came from Greece.

Project 2 and 3 (methodology to control the crew development and the amount of crew necessary to operate the flight mesh) was under the responsibility of the strategic consulting analyst in partnership with the AR team.

Finally to project 4 (update the crew database) was conducted by the senior analyst. As soon as the results of the data base reconstruction project began to appear, a new problem emerged from the MCL[5] (Master Crew List), that were soon incorporated to the project [5].

IV. INNOVATION AFTER CRISIS

We will describe below the three points that came out from the project developed by the team. Indirect gains regarding areas inside the company that are impacted from the project are not described due to the focus given in the interviews, resources, processes and places visited during the research.

A. Crew Career Path

Crewmembers used to be divided in two formal groups: Technical crew and Commercial crew. Technical crew refers to the pilots (Captain and First Officers[6]) while commercial crews refers to Flight Attendants.

Likewise, aircrafts are divided in two main groups: Narrow Body and Wide Body. Narrow Body refers to the small aircrafts used in domestic flights while Wide Body refers to the big ones used in international flights. Examples of Narrow Body aircrafts are Airbus A319, A 320 and even A321. On the other hand, good examples of Wide Body aircrafts are Airbus A330 and Boeing B777.

AIR1 began as a regional company with Narrow Body aircrafts and, with international flights, it has slowly grown to adopt Wide Body planes. The crew career path had a parallel development: it is based on the aircrafts' size (and the expected natural growth of the company). In short, in aviation the aircraft size directly implies crew seniority.

An example helps understand the crew career path in an airline. We are going to describe the technical crew's career path, but the same thinking can be applied to commercial crew.

Let's use for example the crew John (an imaginary just hired technical crew). At first John is hired and after all the training period with simulators and ground school, he began his career as First Officer of a Narrow Body aircraft. After the accomplishment of the minimum flight hours in the narrow body, if there is an available position as First Officer of the smallest Wide Body aircraft, he can be promoted to the next level in the crew career path. To achieve that he has to do additional simulator hours and ground school to the next level (for every aircraft change, a new ground training is required). Again, after the minimum flight hours and if there is an available position in the next level he goes to the next aircraft size as First Officer.

As soon as John completes all the steps to the biggest Wide Body aircraft, and as soon he has the minimum flight hours, if there is an opportunity to the next step, he can be promoted to Captain of the Narrow Body. From this point all the stairway John walked up-stairs from Narrow Body to the biggest Wide Body aircraft has to be repeated as Captain now (Figure 3).

[4] As per national and international regulations, any aircraft crew cannot exceed an specified number of flight hours

[5] MCL or Master Crew List is a list of the crew that are going to fly into some countries. Due to legislation, a list with crew's names and documents information has also to be sent every time an aircraft departs. As the database was not being updated, there was a systematic mismatch between the data in both lists.

[6] First officers are also known as co-pilots.

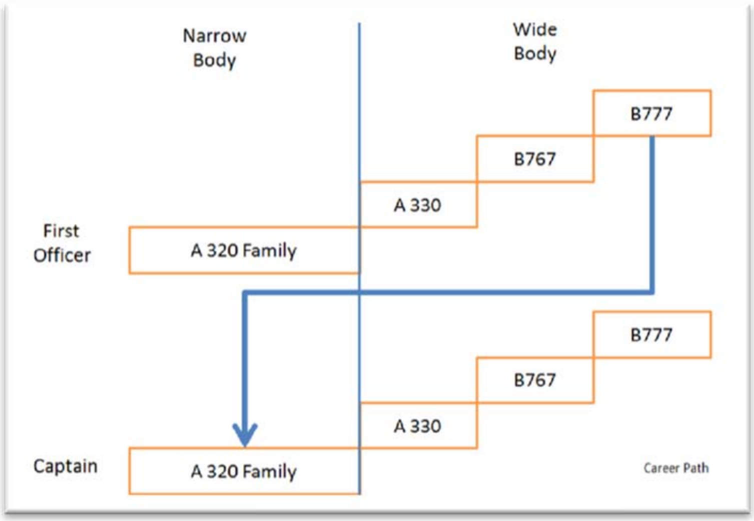

Figure 3: Technical crew's career path.

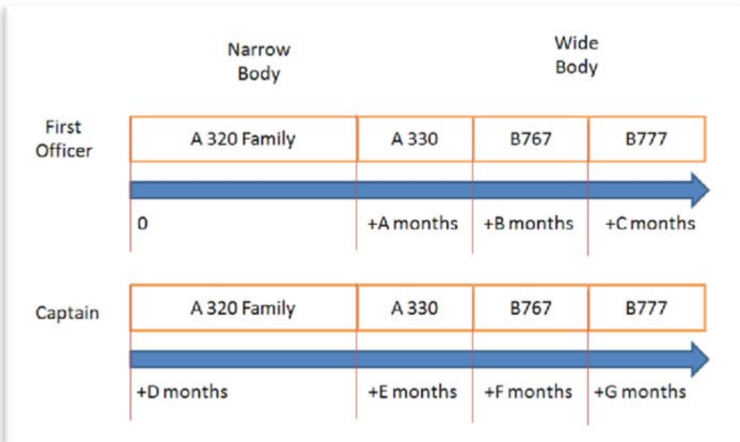

Figure 4: Crew's career time line to readiness for a post. (Numbers occulted because of business reasons)

Due to the career path described above, two main questions emerge directly linked to the strategy of the company: First, how long a just hired crewmember will take to the top of his career[7]? Second, in a scenario of new aircraft acquisition (both wide or narrow body) to the flight operation, how long before the beginning of the new aircraft operation the stairway must be moved to provide the right trained crew? Training time required to crew readiness must also include ground school and simulators. The answer to these two simple questions didn't exist before the project developed by the AR team, what led to a lengthening of the career path as well as the revision of the amount of crews by aircraft for each model[8] (Figure 4).

The number of crew by aircraft model as well as the career path expected readiness time represent improvements to the company's strategy, as well as contribute to a better control over the operation. These improvements still represents a nice Human Resources tool to crew's development.

B. Process control over database and system update

During the database reconstruction, some questions emerged. The first one was how to insure that the lack of database and system maintenance will not happen again?

From the point of view of the crew schedule planning system, the friendly relationship developed during the project with the software supplier team made it easy: every new available update was directly informed to the AR team (responsible for managing the system maintenance update).

On the other hand, the crew database maintenance was a little bit harder, since the responsibility was the operations' back-office, which was in a different branch of the hierarchy. Historically, the resources people hired to the back-office at Brazil (in great part of the business) are not made of top performing professionals: the incomes to these positions are

[7]It can be understood as the sum of times of crew training for each level.

[8] Due to regulation, a crew certified to a specific aircraft model cannot fly other model. In this way, the amount of crew necessary to operate the mesh must be balanced by aircraft model.

not the highest, since their activities do not generate the highest value to the business. Nevertheless, their lagging performance can paralyze an operation [5].

Given these difficulties, an innovative solution was needed. The first idea was to put together the database and the system maintenance in the same process. Following this conclusion, a complex process was initiated to change the operations structure, to have the operations back office near the AR team. This idea was not approved and then a new solution became necessary.

To solve the problem, the team developed a new database maintenance control process: at the beginning of each month a list of next month expire dates (a list of documents renew, health checkups, simulators, visas renew, training and others that must be renewed and made crew unavailable to fly) was created from the database and sent to operation's back-office. The crew then was set as unavailable in the system from the day indicated in the list expire date until the expire date validation and others have been done. This way, the system cannot schedule the crew during this period. Then, the necessary expire date validation is previously scheduled. The operations back office's employee follows the expire date renew until it is done. If something goes wrong, the back office is responsible for the consequent rescheduling. By the end of the month, the crew becomes available again to the schedule planning system.

In the end, the back office's employee asks the crew to send a copy of the document. Finally, in the end of the month the AR team extract a new expire dates report and compares with the previous one. These checks avoid the crew schedule system's use of wrong information and insure that the continuous maintenance is going on (Figure 5).

C. Crew Capacity

The process of crew schedule generation process actually do not began in the schedule planning department. Weeks before the beginning of schedule planning, mesh and fleet department (the department that develop and control the aircraft allocation to the mesh) develop the next month's mesh to enable a projection of crews needed to operate the mesh as well as the load (controlled by the Yield department).

The Yield department estimates next month's mesh load (number of passenger in each flight), to ensure the cancelation of flights with potential loss. At the same time, the crew schedule planning department began the crew schedule preparation. Approximately one week before the crew schedule publication, Yield send to Crew Schedule Planning the real mesh that is going to fly: as some flights have low or even negative profitability, these flights are canceled. At this point of the process, part of the mesh must be reconstructed and the crews allocated to these specifics flights must be rescheduled.

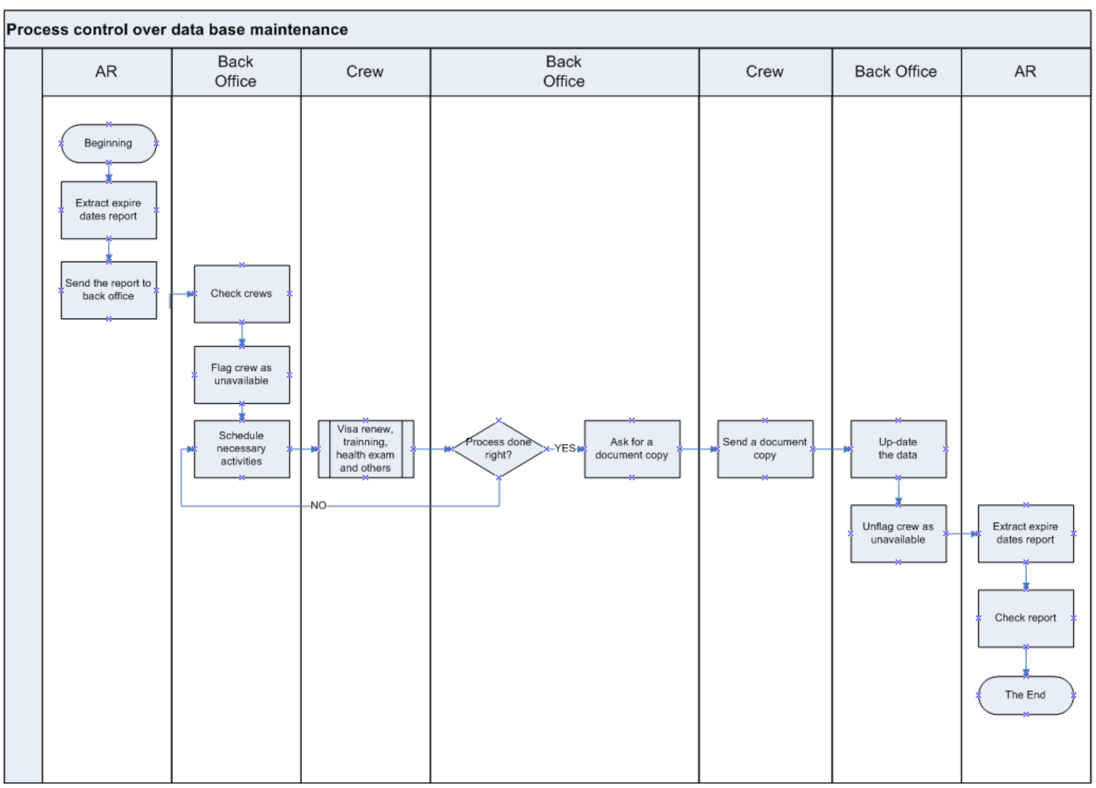

Figure 5: New process control over data base maintenance.
AR and Back Office refer to departments while Crew refers to each crew individually.

Due to this complex set of information, before the existence of AR team it was not possible to know the amount of crew necessary to operate next month's mesh. Using all the information, a new methodology using scenarios was developed to increase the accuracy of crew schedule generation.

The new methodology uses the mesh sent from mesh and fleet department to calculate mesh's flight hours. Then, a projection of how many crews are necessary to operate the mesh is made by aircraft model, as well as divided into Captains, First Officers and Flight Attendants.

Using this information, a simple account is made to arrive at the number of required Captains, First Officers or Flight Attendants: to each aircraft model the total crew number of employees minus the amount of crews away due to health problems minus crews that has some expire date scheduled for next month lead to the number of available crews. Available crews minus the projection of crews necessary to operate the mesh is equal to the number of crews that should go to vacation. Figure 6 and Figure 7 shows an example using A330 Captain.

A list of crews that are near the limit of flight hours (due to Brazilian regulation, there is a limit flight hours to crew at each month as well as by quarter, semester and year) is generated and sent to Crew's manager with the total number of employees that should go to vacation. Finally, some crews of list are invited to go on vacation. (Figure 8).

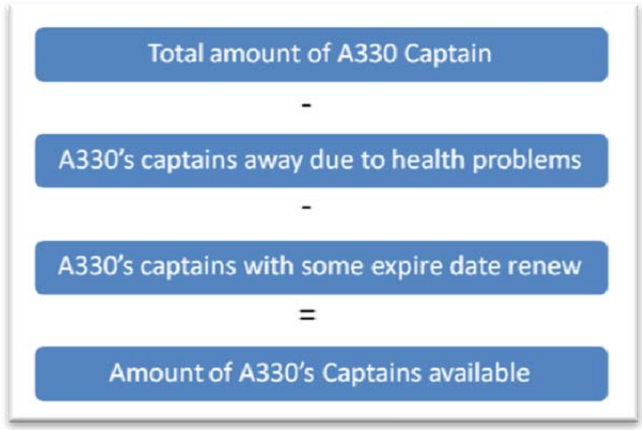

Figure 6: Example of available Captains calculation

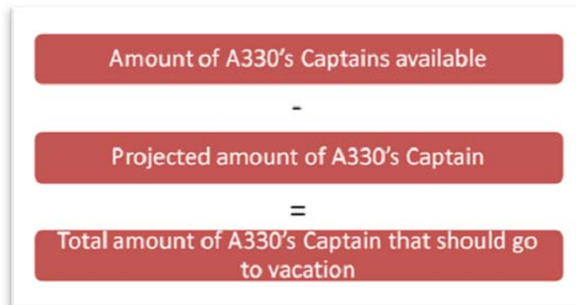

Figure 7: Example of Captains that should go vaction's calculation

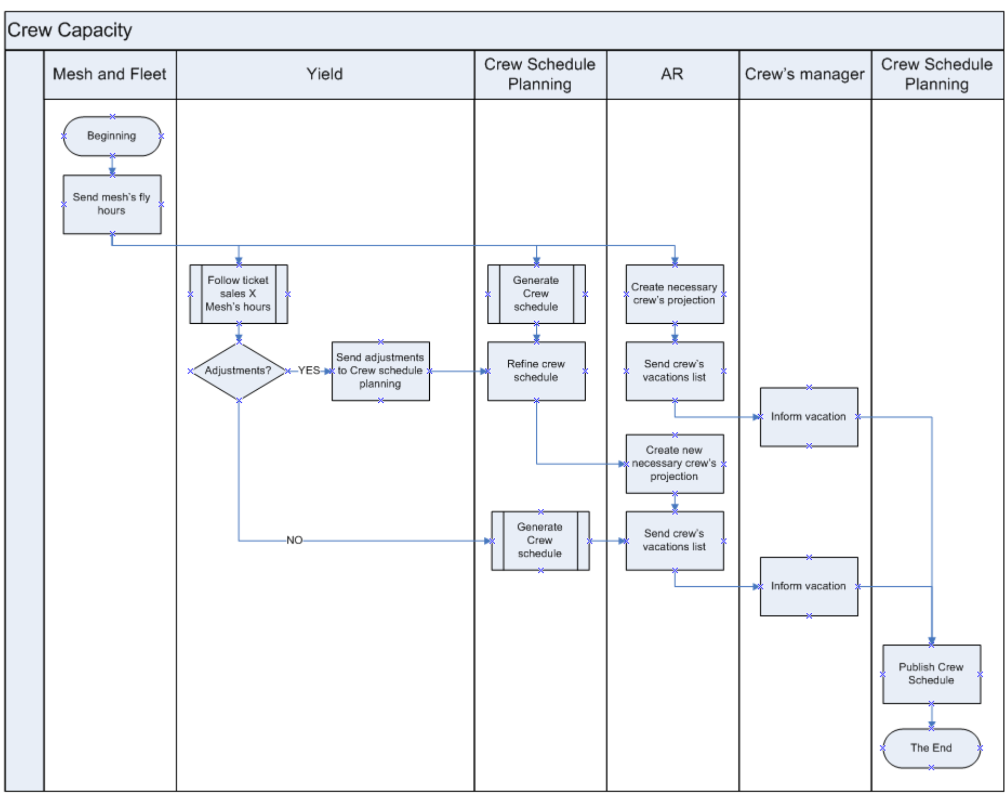

Figure8: Productive capacity's process

Before the development of this new control methodology, it was impossible to project the amount of crew necessary to the next month's mesh. The innovative methodology as well as the development of a new process to organize the information set sent to the different areas made it clear that the new operation (after crisis) is better controlled than the former (before the crisis).

V. FINAL CONSIDERATIONS/CONCLUSIONS

It is clear that the crisis's root control leads to an expressive gain. Using the model proposed by Mittroff, Shrivastava and Udwadia [8], our main conclusion is that comparing the old operational model (before the crisis) under the scope of "disaster management" with the new operational model (after crisis), AIR1 is a crisis preventive oriented organization and this position didn't change. On the other hand, "crisis management" has changed: before the 2010 crisis, the operation was crisis reactive oriented, what clearly changed to a crisis preventive mode with the increased crew control level.

Another point is that the existence of a group as AR inside AIR1 after the crisis represents a change in organization's way of thinking. The direct consequence is the approach's change from a reactive mode to a crisis preventive orientation. Figure 9 indicates the positioning evolution.

Another indirect crisis heritage for the future was a better set of relationships among key departments. The crisis solution required that different departments, that formerly worked independently, after the crisis must work as an integrated system, thus enhancing their synergy. This work as an integrated system is a direct consequence of a new process and a new group that processed the required information integration.

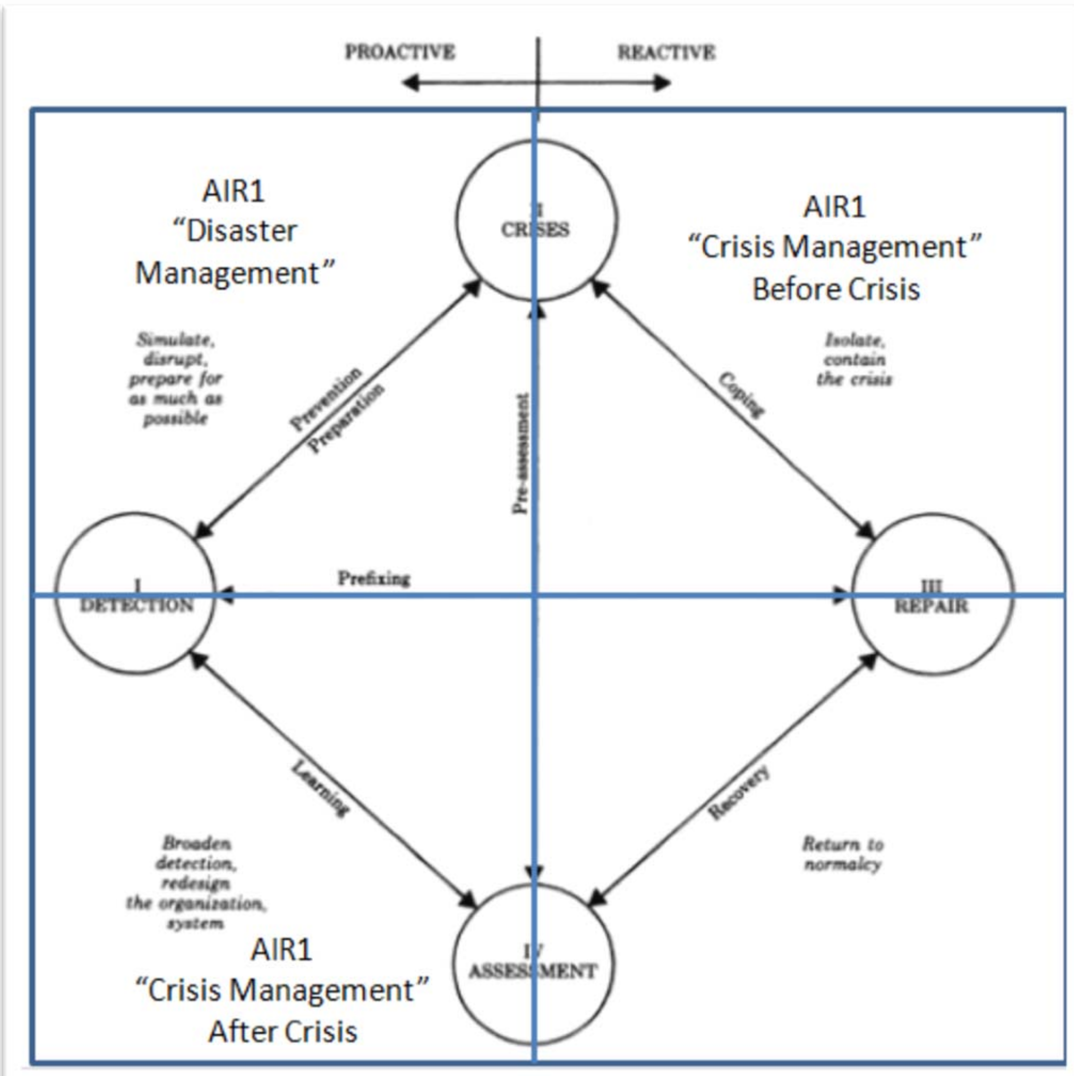

Figure 9: Schematic view about AIR1's crisis management before and after crisis

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