Improving the Art of Decision Making

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Abstract

Most of the decisions made in business do not justify a formal decision analysis because, considered alone, they do not have a big financial impact. In such a case intuition plays a strong role. Now, many small decisions put together also have a big impact. Therefore a method for improving intuition would have a big impact on a manager's performance as well as on his firm's output. This paper demonstrates that practising control charts meets this goal. First we explain that the cause of many errors is the incapacity to detect a stable state, next we show how practising control charts helps to remove the cause by intuition. We give three typical examples of errors and the way to avoid them.

Introduction

In any company major decisions have to be taken, mainly regarding the overall direction the company is to take and how it intends to achieve its aim. These decisions, that have a big financial impact, may well justify careful and formal decision analysis, with all the expense and management time required. But there are also many other decisions, of lesser importance which, when taken alone, are not so significant but, when taken together, can be very important. The result of an accumulation of small decisions in business is so great that sometimes a successful manager's career can be explained by his skilful decision making. For example, these may well be the decisions which determine how well the "grand decision" is carried out. More generally, the life of a company is influenced by a multitude of small decisions that people make according to the circumstances, often without any real consistency.

For these various decisions, intuition plays a strong role. It is generally admitted that the most simple choices, for example deciding either to take the train or to drive downtown to do some shopping, are just a question of common sense. We do not know very well the mind process that leads to these decisions ; we would like it to be rational but we have to admit it is not true. The process is partly beyond analysis, because of intuition. The fact is that intuition is shared unequally, and science tends to distinguish here, as in all questions related to the human mind, innate and acquired factors. The following questions arise : is there a way to improve the intuitive "decision making" of managers ? And is it possible to compensate for weakness associated with intuition ?

Another question arises concerning major decisions. A manager who wants to optimize some important decisions can appeal to decision analysis methods ; but is it possible to find a completely rational decision ? Of course not ! For instance it is well known that statistics can be distorted in order to support government decisions, taken for political reasons, with so-called objective considerations. Generally speaking, many cases are known in which chief executives have deliberately dismissed the conclusions of experts based on a rational study so as to make an important decision based on their own intuition.

Much work has still to be done to understand the thought process that put a decision in practice, because rational and irrational factors are linked within this process. This study will demonstrate that there is a way to improve the global process by improving the manager's intuition. First, let us define what is a "right" decision.

What is a "right" decision ?

We will adopt the single point of view of the person who makes the decision. Since a decision is always preceded by a goal, either stated explicitely or not, our definition is that a right decision is one which helps the decision maker to reach his goal. It is common to say that people never reveal their goals completely, for many reasons : either an individual is not clearly aware of his goals ; or he/she is so much used to lying to others that he/she finally lies to himself/herself ; or he/she has several conflicting goals and therefore his mind is not made up ; or simply he/she has learned that too much honesty could cause him/her problems. We must emphasize that the present definition takes into account the real goal of the decision maker, not the goal that other people would expect. Therefore the decision maker is the only judge of the value of his decisions, and he cannot be certain that a decision was "right" as long as he did not see the consequences. However, the decision rules presented in this paper can sometimes provide him with evidence a priori that a decision is "wrong".

We must temper this definition by the fact that, for important decisions, the decision maker often takes advice from people that he trusts and to whom he talks about his/her goals more frankly. In this case, he can evaluate the effects of his decisions later by taking advice from these people again.

Sketch of a decision process

According to the usual theory, decision analysis includes three steps. The first one is an inventory both of the actions that can be done in order to obtain the required results and of the resulting events. The second phase is a representation of the considered actions and events on a decision tree. An event leads to a decision node (i.e. under control of the decision maker) and an action leads to a chance node. A chance event is represented by a path coming from a chance node. Probability and stakes must be alloted to the decision tree and the main problem for the decision analyst is to appraise them. The third phase consists in making a strategy that maximizes the expected utility of each decision (i.e. the sum of the products stake x probability). The expected utility is often compared with the amount of money that a well-advised person would accept to pay for a lottery ticket. Therefore decision-making would be similar to the problem of the rational choice of a lottery ticket (fig 1).

But life is not a mind game and this process is seldom followed, even in organizations where decision analysis is systematically applied. After half a century of living together, statisticians and decision makers have not yet the same kind of reasoning and cannot cooperate efficiently.

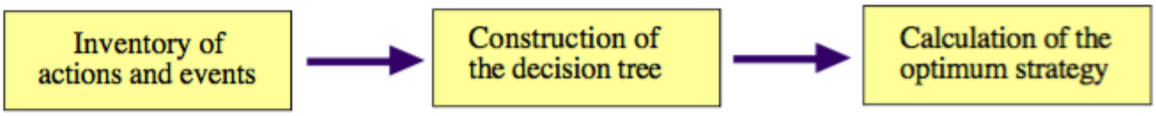

Fig. 1. *Rational decision process*

The first obstacle to adopting a rational process in practice is the skepticism of decision makers about calculated probabilities. In scientific terms, the announcement of a probable event is a prediction to which a probability must be linked. Now, the universal statistician's rule is to take the frequency of past events as the probability of future events. For example when statisticians say that the probability of an accident is 0.05 per year, it is because an average frequency of 0,05 per year has been observed. But the rule is valid only when the observed frequency is stable, under control, according to Shewhart's operational definition. Since this condition is not always met, decision makers are well-advised to be careful.

« Would a person on foot ford a river in an unknown place when he has just heard that the average depth was two feet ? » asked a humorist.

Another obstacle is the dreadful spectacle given to the decision makers of the business world by quarrels bteween experts over economic predictions, such as the prediction of economic growth, where people are trying desperately to prove that they are right with questionable reasonings.

Then we will try to find an empirical model, closer to actual decision processes, where intuition must intervene. People often say that intuition is an innate talent that some people have more than others, like good sight or sharp hearing. It is not true because intuition, as modern philosophers describe it, is a way of thinking which stems from reason, that generally improves with experience and that somebody can also improve by appropriate exercises. We could say that intuition is half-way between animal instinct and rational induction. We suggest a five phase model.

The process is triggered by some critical events, that can be either personal observations or a piece of information from outside. According to the circumstances, the decision maker will see these events either as a problem or an opportunity related with his goals. In the first phase, he mentally compares the new circumstances with situations he came across in the past, trying to take advantage of his experience. This thought gives him the idea of possible actions. In the second phase, he makes the inventory of these actions and starts thinking about the required time, the required means and the possible effects. In the third phase, he selects different options after considering the obstacles and the chances of success. In the fourth phase, he imagines a scenario and makes a plan for each option, based once again on his experience. Finally, in the fifth phase, he takes his decision, "letting himself be guided by instinct", as people used to say (fig 2).

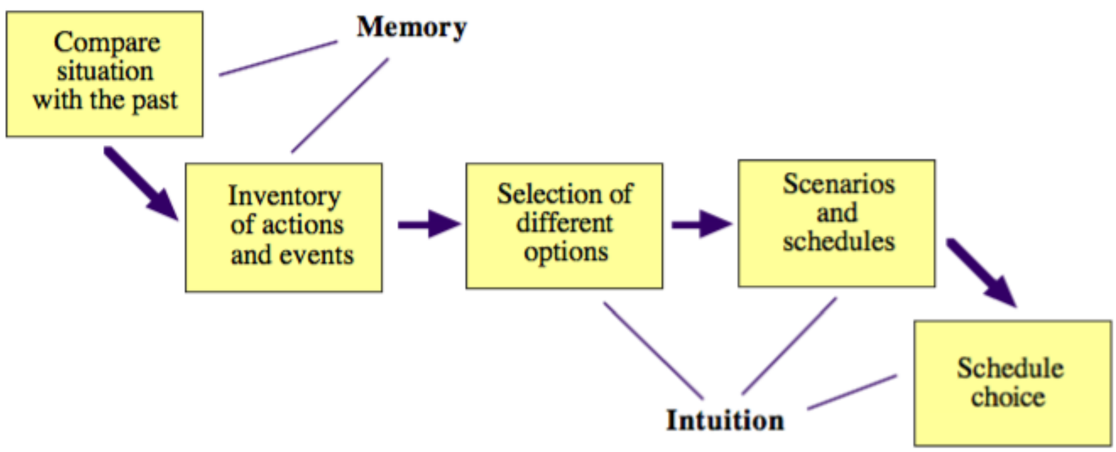

Fig. 2. *Sketch of an actual decision process*

This is not an ideal process, but it is realistic. Looking at this sketch is important because the decision maker can improve his own decision process only if he has a clear understanding of his own way of thinking. Now we can present here a method that has enabled thousands of people to improve their intuition, not making it rational, but just reasonable. This method is the sharp vision of variations in all circumstances. To begin with, we must understand that there is no such thing as a rational prediction without stability.

Can one believe in a rational prediction ?

Let us do an experiment. Take 112 ping-pong balls and write a number on each one. Write an integer on each one ranging from - 10 and + 10, in order to make a symmetric distribution (fig 3). Put them in a large cylindrical can. After carefully mixing them, ask somebody to draw successively five balls, blindfolded, and to put them down, in the same order, on the table. The result of this experiment, of course, is a pure random series. Therefore any comment about variation between the numbers written on two adjoining balls would be nonsense. On the other hand we know empirically that the average of the five numbers is rarely far from zero and that the average of the averages after several experiments will tend towards zero ; this fact leads to a rational prediction.

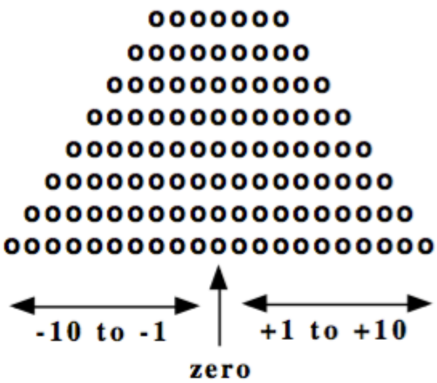

Fig. 3. *Distribution of 112 ping-pong balls*

Now let us imagine that a demon would come and disturb the experiments by removing for a short period of time the positive balls from the operator's hand, and some time later the negative balls. The Maxwell's mythical demon, the thermodynamics troublemaker, can do it. Any rational prediction becomes impossible. Fortunately when we look at the run chart representing several experiments, we immediately understand that they have been disturbed. By definition we say that in the first case the run chart expresses a stable state and in the second case a state of chaos.

The first step towards having a sharp vision of variations in all circumstances is the knowledge of Shewhart's operational definition of a stable process : a process is stable when nothing permits to distinguish the actual run chart from a run chart obtained in the ideal bowl experiment (Shewhart performed it with chips in a bowl). Statisticians can notice that the definition is based on a physical model, not a mathematical one. Next it is a matter of making calculations in order to arrive to the conclusion that the process is either stable or not. Despite the fact that the formulas are based on the probability theory, it is not necessary to be learned in mathematics. Simple arithmetic is enough.

There is much difference between this theory and the theory of the time series that some statisticians like so much. The latter starts from the basis that any experimental time series contains something useful for making rational predictions. These statisticians claim that any time series allows one to predict that the average will be either constant, or part of a trend, or submitted to cycles. To their minds perhaps the time series plays the same part as the chicken's innards in the eyes of an African sorcerer. Meanwhile Shewhart's theory is based on the idea that any experimental time series must express either a stable state or a state of chaos, without any other alternative, and that only a stable state allows one to make rational predictions.

Two classes of events and decisions

When you want to solve a problem or improve a performance, you start generally by looking for the related causes. As it has just been stated, if the time series reveals that the process is stable, you must give up explaining variations by a particular event ; they belong to the system. On the contrary, if the time series reveals that the process is out of control, you can identify a particular event as the variation cause at the time. Therefore you must distinguish between two classes of events. By definition, those that you do not attempt to identify because they do not have a real effect on the process are the common causes of variations. On the contrary, those that you must detect before any decision are the special causes of variations.

You must also distinguish between two classes of decisions. When the process is in a stable state, the rule is either to change the system or to do nothing. The efforts must be directed towards the system understanding and changes for improvement. This action can take a rather long time. When the process is in a state of chaos, the rule is to find as soon as possible the event that disturbed variations. If it is harmful, you must prevent it from coming back or neutralize it. If it is helpful, you must generalize it for improving performance. The efforts must be directed towards understanding the special causes of variation and restoring a stable state. It is clear that a stable state is always preferable to a state of chaos because rational predictions can be done then. If the decisions take the wrong direction, the performances will just deteriorate. The bigger the efforts, the faster the deterioration.

When a decision does not suit the situation, you are immediately able to know that it is wrong, before of the results you obtain. This issue is summarized in table 1. In business it is important to distinguish between these two classes of events and decisions. The people who try their hardest to increase their chances of success without knowing the above rules suffer great disappointments because the contrary often occurs. When a decision is not in the appropriate class, the performances can only deteriorate.

A simple way to reduce the rate of error

The charts used to make a judgment about the system's stability are called "control charts". Finally the decision rules just consist in following the messages given by these charts. As long as they do not deliver particular signals, you must consider that the system is in a stable state. The description of the unstability signals can be found in books, namely Dr Wheeler's *Understanding Statistical Process Control*. Finally, these charts can be used by any manager in order to reduce his/her own rate of error, therefore to improve his/her performances. The answer to the question asked in the introduction : Is there a way to improve the intuitive decision making of managers ? is : Yes, with control charts.

Table 1 shows two types of errors. The first one is to look for a special cause of variation, a particular event, when the control chart emits no signal, i.e. the system is in a stable state. The second one is to do nothing or to decide to change the system when the control chart emits a signal, i.e. when the system is in a state of chaos. It is easy to understand that if the decision maker considers that the system is always stable he will never commit a type 1 error and that if he considers that the system is always unstable he will never commit a type 2 error. These two opposite behaviours would be nonsense because the rate of error would be tremendous. Nevertheless the use of control charts cannot reduce this rate completely. It may happen that a control chart does not reveal a special cause that does exist ; on the contrary, a control chart can make you look for a special cause of variation that does not exist. It is impossible to calculate the probability that false signals appear and that true signals do not. The worldwide experience of control charts, involving thousands of people for fifty years, gives the assurance that the risk is very low. This is the reason why control charts are so helpful for decision making ; they optimize the decision process.

		Decision	
Status	**Diagnosis**	Stress a particular component, suspected of being the cause of the trouble	Either change the system or do not change anything
System under control (stable)	Common causes of variation	**Error type 1** performance will deteriorate	**O.K.**
System out of control (unstable)	Special causes of variation	**O.K.**	**Error type 2** The problem will remain

Table 1. *Decision errors*
The risk can be reduced by making the distinction between two classes of events

How Control Charts improve intuition

In everyday life we are faced with figures : prices in stores, taxes, childrens ratings at school, sport results. The same is true at work : orders, production costs, yields, defect rates, salaries, etc. Variations of numbers are a constant issue. If we are reasoning just by intuition, we tend either to overestimate them or to neglect them, according to preconceived opinions. On the contrary control charts users have a better vision of many problems and their decisions are more effective.

In practice, people cannot draw control charts before any decision because the required numerical data are not all available at the right time and anyway they would lack time to do so. There is no harm because control charts have an indirect effect on decision making. The testimony of many decision makers reveals that a constant use of control charts improves their intuition. As I mentioned above, intuition naturally improves with experience. The exercise of drawing control charts and making some calculations in order to know if a process is stable, either in private life or in their job, leads people to consider good news, bad news, data, ratings, etc. in another way, as though they had new glasses. If it is done regularly, the exercise changes the relative importance that people attach to events, therefore it changes the organization of their memory. It also removes from people's minds a lot of preconceived ideas.

A big mistake about performance

A decision maker should be also concerned by the problem of individual performances because many decisions are based on a prior judgment on performances. When this type of jugment is made (e.g., Mike is a high performance salesman), management tend to consider it as a fact, but this is a mistake. The variation theory provides better solutions than the usual method of rating and ranking to the problem of individual performances.

If a system is stable, the variations are produced by the system, not by the people. This statement which could be called the *Central Deming Theorem* is illustrated by the famous "red beads experiment" (probably performed about one million times in the world since Deming did it in an American four day seminar in 1980). Obviously, it is a fact that when several employees do the same job in a company, performances appear in the form of numerical results (e.g., outputs). This theorem means that when (and only when) a system of performance is stable, the management of the company must consider that attaching a certain performance to an employee because the performance appeared "in his hands" is nonsense. Performances are randomly distributed among people.

Finally, the concept of stability, according to Shewhart, has led us to consider two classes of events, two classes of decisions and two types of errors. This is illustrated by three examples of the most typical errors in management.

First example : an error that costs money

In the famous book *Out of the Crisis*, Deming gives a vivid example of a decision error in an American business establishment. One day the president received from his firm's insurance company a letter saying that unless there was a drastic reduction in the frequency of fires in the company's premises, the insurance company would cancel the insurance. Ill at ease, he sent a letter to every one of the 8,500 employees of the company to plead with them to start fewer fires. Therefore he considered the problem as if the employees were able to solve it.

Deming examined the files and made a control chart. He concluded that the system was stable with an average of 1.2 fires per month. The upper control limit (a calculated threshold) was five fires per month. There was no dot going above this limit (fig 4).

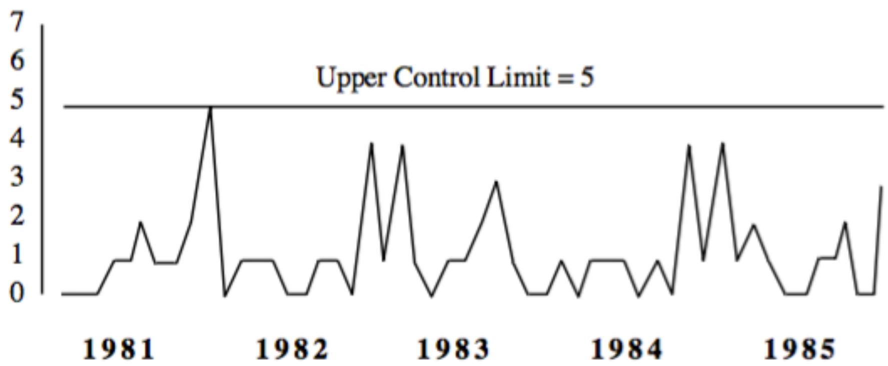

Fig. 4. *Plot of the number of fires per month in a business establishment*

« Had someone in the insurance company observed that the system of fires is stable, Deming said, they would have a good basis for the rate to set to make a little profit and please the customer. »

From the establishment's point of view, it is possible to reduce the number of fires provided that management people study the system and find a global solution. This attitude is completely different from considering every fire a special event. As long as management people do not recognize that fires are produced by the system only, the improvement process will be blocked. One must extinguish every fire of course but the goal is a reduction in the frequency of fires. They can do it by considering any fire as the output of a stable system, not as the result of a special cause.

Second example : an error that demoralizes people

This example was observed in a Swiss bank. The steering committee was talking about loans. Somebody gave figures relating to loan capital, credit conditions and some problems encountered. In particular some requests could not be met because the files were not complete at the right time, so the bank risked losing important customers. This happened in May and the defect rate had been increasing since January. The general manager felt irritated at these figures (Fig. 5) and demanded that a survey be carried out, followed by sanctions.

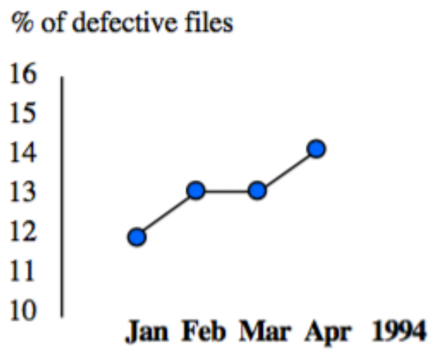

Fig. 5. *Plot of the defect rate per month for the last 4 months in a bank*

Nobody was surprised by the attitude of the boss : it was so obvious that people must do something in this case ! The quality manual said that the company must be reactive and that the only objective must be "zero defects".

But if we look at the figures of the previous year (fig 6) we see that the average rate of incomplete files was 12,3 %. The most distant dots are 11 % and 14 %. The general manager felt irritated because the results varied from 11 % in January to 14 % in April. Now we see that the same increase appeared from May to August last year. If these people did not improve the situation last year, how could they improve it this year without changing their approach ?

Finally, the variation theory increases the ability of the steering committee to make efficient decisions. The present control chart says that the situation is stable ; therefore the variations about the average cannot be explained with a special cause. Like in the lottery experiment, we just see random variations and the rule is to do nothing. But if the the dots go beyond the control limit, the control chart says that there is a special cause and the steering committee has to do something immediately. The control limit is a decision threshold ; the calculated value is 15,7 %. If the committee does something when the dots are under the control limit, this may be a costly mistake. In a steering committee meeting, the results should be presented on control charts, with average and threshold, in order to reduce the decision mistakes. It should be also noticed that the steering committee can do something at any time with the intention of decreasing the average, but there is no reason to do it when the result is 14 % rather than 11 %. They will do it in the framework of an improvement programme that requires a careful study of organization, methods, customers, etc.

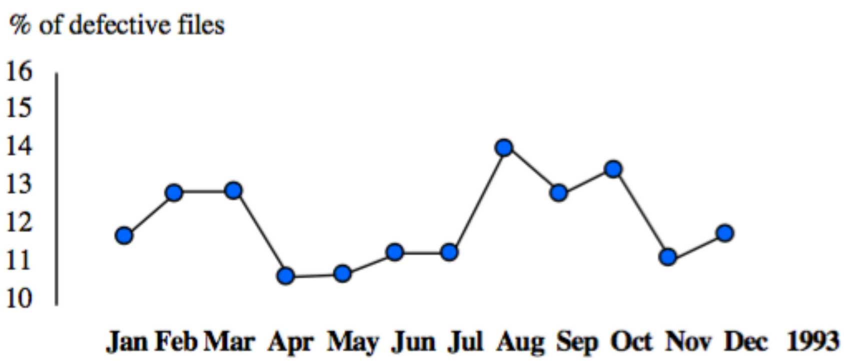

Fig. 6. *Plot of the defect rate per month for the previous year in the same bank*

Third example : an error that causes trouble in management

A clothing company has a group of salesmen visiting retail stores. In this company the measure of the salesman's performance is the individual sales figure per month. Now it seems only natural that management should compare figures. Then the salesmen's names are put on a list in order of their performance every year.

One day, on a railway platform, I met a man that I knew by sight. I remembered that he was a salesman in the clothing company and that he got the prize of the salesman of the year (a picture of him was in a newspaper). « Are you still happy at X...'s ? » I said. « No, I'm leaving them, because I made a bad turnover last year. »

The variation theory says that when numbers are produced by a stable system, each number is put on the distribution at random. In other terms, a man's performance which is on one side of the average one day can be found on the other side some days later, though the man's behaviour is exactly the same (Fig. 7). Therefore it is irrelevant to judge individual performances when the system is in a stable state. In this case, nobody is accountable for a performance because the variations are entirely due to the system. You can judge individual performances only when the system is in a state of chaos. Though I could not verify in their files that the sales of the company were under control, I think that the prize of the salesman of the year was an illusion and that the fact that a salesman was dismissed because of a bad turnover was a mistake.

One can hardly imagine how stressing individual performance is prejudicial to the company. Whereas this system aims at improving total performance, in fact it always leads to decline. Concerning psychology, this system fosters suspicion, untruthfulness and rivalry between colleagues. Concerning technique, the average performance remains the same while the scattering of performances increase ; now it's well known that scattering is a big source of waste. It is a great pity to see that attempting to motivate people in a company has such harmful effects.

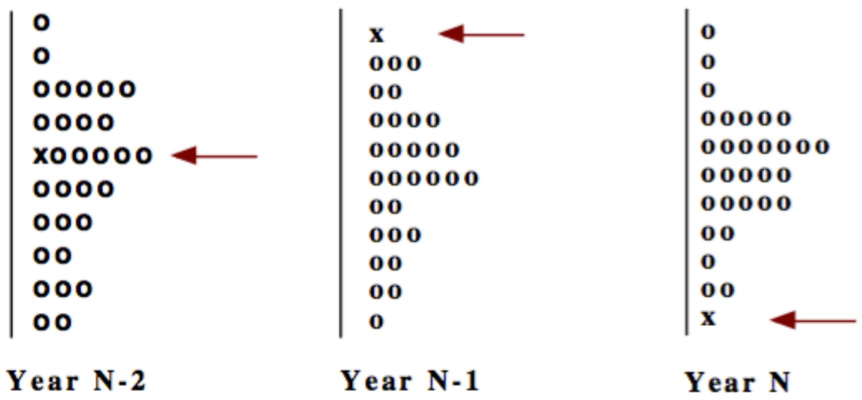

Fig. 7. *Random performance variations in a team of 31 people.*
The system is stable ; **x** *is the same person)*

Conclusion

Without being good at math, everybody can improve his/her ability to make good decisions, by constantly using control charts. This practice gives people, as Deming said, « the sense of variation ». It is an interesting exercise that always leads to good results in the long term.

It is amazing to see how professional statisticians so often disregard the variation theory, whereas they are so fond of new mathematical tools. And yet this issue has a tremendous impact on economics because it is the art of using data from the past in order to optimize the decisions for the future. This lack of interest perhaps comes from the fact that the variation theory involves a new philosophy before offering a desperately simple technique, whereas university education is interested very much in complicated techniques and a lot less in philosophy. But whatever some professors may preach, a manager can find great benefit in experimenting with control charts for his/her personal use.

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