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Business continuity, enterprise risk & resilience updates

Probability of events: the underrated factor of the risk assessment

By Alejandro Aristizábal Correa

*"**I was especially pleased in mathematics for the certainty and evidence of its reasonings ...**"*

René Descartes

The emotional stability that certainty brings to us is so deep and lasting that it is difficult to compare to another concept of the natural order.

When it comes to information, no factors have such an impact and powerful consequences as those that allow reliable estimates of upcoming situations or future effects of decision-making.

Continuity and risk planning and organizational decision-making depend not only on the reliability of the information but also on the consistency and suitability of the methodologies and tools used. This means that the accuracy of information on which we base our decisions and projections is not enough. Rather, the models used must accurately fit the situation so that they can produce consistent results in every experiment and business situation.

Unfortunately, predictive models cannot always be tested within a realistic scenario. It is unusual for this to be the case; therefore, it is not expected that in practice the results will be the same as the theoretical calculations. Further, the models must ensure a sufficient degree of precision, so that we don't need to cross our fingers when the expected time comes.

The tool used by enterprise risk management (ERM) and business continuity management (BCM) for the estimation of future events is known as a risk analysis. Despite the fact that its use is recurrent and its methodology is similar throughout the world, the variety of approaches used to calculate the probability of risks of the same phenomenon is wide enough not to consider the average of an interruption probability calculated independently by two risk experts, using the same model, as a professional practice.

The concept of risk as a forecasting tool in business has existed since at least the 4th century BC, and although the use of probabilities, after its academic development during the 16th century, entered industry after WWII, we cannot affirm that its practical use has matured in the same proportion. In fact, its application is often replaced by our intuition.

For instance, when we are presented with the estimated calculation of the accident statistics at a crossroads in a time slot, or the statistics of a basketball player, the idea of a rational number jumps to our mind: $\frac{number\ of\ successes}{number\ of\ trials}$. Unfortunately, the probability of a large number of phenomena cannot be calculated using frequencies, e.g., the probability of a flat tire/tyre puncture after its wear has reached the time for tire replacement, or the probability of a power plant failure after five years of operation.

To have an idea of the relevance of a suitable probability model let us think about the financial calculations used to ensure that a budget is available for risk control and in the continuity of operations. Although maintaining the same care should be the consequent procedure when trying to determine the distribution of said budget in accordance with the risk map, the accuracy of the probability of events is not always taken as a key factor in a risk assessment. To keep this effort focused an accurate probability, calculation is needed; otherwise, the money will end up in other less relevant risks, possibly exposing some critical ones.

Organizational processes, as well as the technological platforms that support them, are the productive machine of organizations, so that their interruption is equivalent to a business interruption in some proportion. And although this is a well-known concept, the methodology and mathematics used to calculate the level of risk of interruption of products / services / processes (hereinafter, processes) should be perceived by organizational leaders and consultants with the same importance. Now how do we properly calculate the probability of interruption of a process?

We´ll see that the answer comes with an understanding of the process or system itself (p/s). For now, we can say that an organizational process is, probabilistically speaking, more like a power plant than a crossroads. In other words, the empirical probability ($\frac{successess}{trials}$) may work for a crossroad but not for calculating the probability of failure of a power plant, nor the probability of interruption of an organizational process.

To evaluate the suitability of a model for calculating the probability of interruption of organizational processes, it is convenient to do it from a new perspective. This involves forgetting a little of what we think we know about the behavior of organizational processes in general: and recognizing that the characterization of a process, its activities workflow, inputs, outputs, technological interdependencies, resources and roles, are insufficient to make future estimates of its probability of interruption.

Perhaps the most important difference between the probability of an accident at a crossing and the probability of failure of a power plant is that the former is carried out in a time slot, which means that a constant average event rate can be assumed, while the latter involves a variable events rate. Stochastic processes of variable rate require the use of models that incorporate the behavior of the rate of events over time, so that when it comes to the probability of events of a p/s that changes with the time, the equation must consider the life time of the p/s and the interval of interest where its probability is wanted. If not, a reasonably reliable estimate cannot be expected.

Of the three types of existing p/s[1], namely:

Type-I: p/s that degrade over time and undergo changes (including replacements) and maintenance throughout their useful life.

Type-II: p/s that fails once in its lifetime. Does not admit repairs or maintenance.

Type-III: p/s that evolve over time and undergo changes (including replacements) and maintenance throughout their useful life.

Organizational processes and technologies are of the Type-III. To calculate the probability of interruption of an organizational process or an IT platform in any time interval, it is necessary to know its behavior in a specific period of its useful life in relation to its changes and maintenance performed until that time. Thus, the more we know about the p/s and the more relevant parameters we put into the probability model, the greater the level of certainty that we can expect from its calculations.

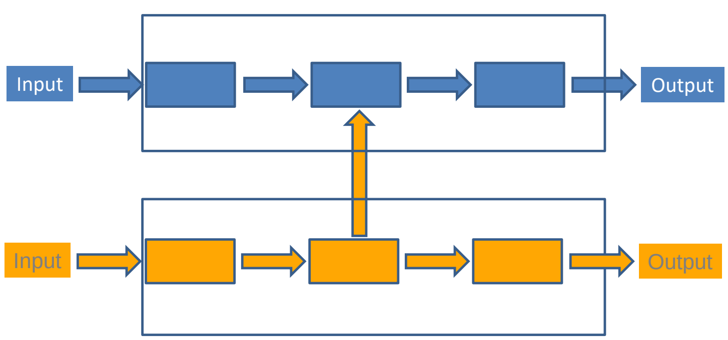


Diagram 1 – Representation of two interdependent processes

Diagram 1 represents one of the images that comes to our mind when we think of a process. A close-up allows us to know its inputs, activities, roles, and related technologies.

Although these technical details are particularly

[1] Aristizabal, A., (2020). *Probability of Interruption and Business Impact*

important, the probability of disruption requires a different perspective to notice the process stability. In other words, the key to the probability of interruption will not be revealed through its functional details, no matter how deep the analysis we make if we keep on our familiar corporate perspective.

Nevertheless, the scope of the probabilistic analysis may go from a process' activities to its threads and interdependencies with other processes, and from the technological infrastructure to its applications and integrated solutions. However, we can have acceptable probability results by taking the process as a single block without considering each of its components, as long as we have a well-suited model that represents the effects of repeating failure with unknown root causes, the process' interdependencies, its updates, maintenance, and a well-shaped rate function at a convenient process level, e.g., Level II or Level III within the process map.

The following are some of the most important features in probability of interruption of any organizational process which apply similarly to technology platforms:

Lifetime or useful life of the process:

It is not usual to define the expiration date of a process; that is why we can consider that a process has infinite useful life, and from the stochastic point of view it is perfectly valid.

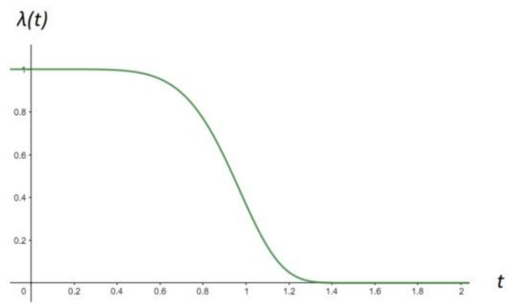
Process maturity:

When a p/s gains stability over time it is called an evolutionary process (or evolutionary system) or a Type-III process. This property is present in various natural processes such as the evolution of species or the first half of the life cycle of living organisms. On the other hand, unnatural processes may evolve only with some type of recurrent intelligent intervention (artificial or human). The rest of processes decay, obeying entropy (second law of thermodynamics), such as in the case of material fatigue, oxidation, nuclear decay, and decomposing organic tissue.

Interruption rate:

This is a characteristic that is linked to the maturity of the process and is strongly related to the probability of interruption.

Imagine that a technology platform has just gone into production, after having passed all functional and technical tests. Although the platform has passed the due diligence testing, there is undoubtedly more chance of failure in the first week than in the third month of operation, and more chance of failure at this stage of its useful life than within two years. The function that describes this behavior is called the variable events rate and it is represented by Graph 1, below.



Graph 1 – Events Rate Function of an Evolutionary Process

An evolutionary process is comprised of three main phases: *Stabilization*, *Development* and *Consolidation*. In our example, the *Stabilization* phase is characterized by corrective changes and major applications parameters and integration tuning. This phase is seen as a plateau in Graph 1 close to $t = 0$.

The *Development* phase is characterized by minor adjustments with a significantly lower probability of interruption than its previous stage. The *Consolidation* phase starts with a positive slope change and goes until the end of the process' useful life; here is where the curve starts its asymptotic tendency towards the least expected interruption events.

In 2018, the creation of the Variable-Rate Probability Distribution (VRPD) theorem proved that the events probability of any variable-rate p/s (eq1)[2] is completely defined by the following equation.

$$P(X = 1)_{t_a \leq t < t_b} = \frac{1}{K} \int_{t_a}^{t_b} \lambda(t) dt \quad (eq1)$$

Equation 1 is quite revealing. It is used to determine the probability of events of any variable-rate process (including evolutionary processes) with only knowing the function that represents its events rate function λ (t).

To have a more accurate interruption probability of an organizational process, the calculation must include all the sub-processes that compose it as shown in Diagram 2. However, as it was explained above, it will be required if a more detailed calculation is required.

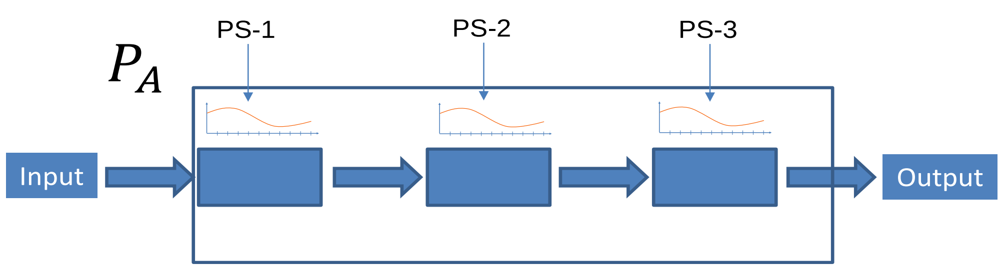


Diagram 2 – Representation of an organizational process with its sub-processes and their respective Events Rate Functions

[2] Aristizabal, A., (2020). *Probability of Interruption and Business Impact*

The author

Alejandro Aristizabal was born (1972) in Medellín, Colombia, Graduated as Electronics Engineer and with a MSc in statistics. He has been teacher of Digital Electronics, Electromagnetics Theory and Radio propagation at USB Colombia.

He created an IT, risk management and business continuity consultancy company in 2012 with the purpose of providing new ideas and academic support to the concepts underlying the consultancy practices.

In 2018, when seeking a solution to calculate the probability of interruption of organizational processes, he discovered the probability distribution function for any variable-rate process (Variable-Rate Probability Distribution - VRPD) along with another theorem and mathematical models applied to business continuity.

With more than fifteen years of experience in telecommunications networks and business continuity in more than six industries, Alejandro Aristizabal is the author of 'Probability of Interruption and Business Impact', a book that approaches business continuity from a mathematical perspective, including some fundamentals on Risk Level calculations. The book includes a personal perspective on business continuity, but also the mathematics underlying the Evolutionary Processes' interruption, including some interesting discussions about the effects of an organizational process' interruption as well as the application of the VRPD theorem in reliability theory. The book is available as printed and Kindle versions on Amazon.