

EVALUATION OF CRISES AND ITS MANAGEMENT

Vis-à-vis

A MATHEMATICAL APPROACH

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Abstract:

Crisis / Impulsive crisis is the combination of different losses & adverse situations. Adverse situation may hamper the output of the organization or can stop the production system. Every organization has planned to avoid crisis situation for very initial stage. If we are manage to calculate the crisis / impulsive crisis or crisis in department and also be able to calculate the recovery after the crisis then we will be able to analyze the impact of crisis under different situation. The article attempts to provide a model for calculating the impulsive crisis & its recovery as well as the departmental crisis & its loss estimation with the help of Boolean algebra.

Key words: Crisis, Impulsive Crisis, Departmental Crisis, Crisis Evaluation, Loss Estimation Due to Crisis.

INTRODUCTION:

Crisis literally means an “emergency” or “urgency”. Crisis is also defined as “such events which act as a turning point for better or worse”¹.

The word crisis comes from the Greek word ‘Krisis’ which means differentiation or decision¹. Although in legal spheres the term was used to describe the differentiation between just and unjust, the meaning varied when used in medical, political and economical context.

The late US President John F. Kennedy noted, “When written in Chinese, the word crisis is composed of two characters - one represents danger and the other represents opportunity”².

Many researchers and scholars over the years have tried to define crisis and crisis situation. While Pauchant and Mitroff³ believe that a crisis is a “disruption that physically affects a system as a whole and threatens its basic assumptions, its subjective sense of self, and its existential core”; Fink (1986), Kash and Darling (1998)⁴ add that a crisis is referred to as an unplanned event emerging from the internal or external environment of an organisation, region or country which can disrupt operations, threaten people physically and mentally, and endanger the viability of entities no longer able to cope with the situation using normal managerial producers. Dirk Glaesser tries to understand ‘as a dangerous and extraordinary situation in which a decision must be made under time pressure. He further states that crisis is seen as a critical change in important variables that endanger or destroy either parts of or the entire system’⁵.

Selbst¹ on the other hand, defines a crisis as “any action of failure to act that interferes with an organisation’s ongoing functions, the acceptable attainment of its objectives, its viability or survival, or that has a detrimental personal effect as perceived by the majority of its employees, clients or constituents.”

Faulkner⁶ observed that in the above definition of crisis Selbst (1978) has mentioned two things- first there has been inaction on the part of the organisation. Secondly, the crisis has a negative effect. But we need to remember that most of the crisis hitting the Tourism Sector is not due to the organisational inaction but it occurs “all of a sudden”, “unexpectedly”. At times there is momentary inaction on the part of the

organisation when some new and totally unexpected crisis happens like 9/11 or Tsunami.

John M Penrose⁷ also talks about perception of a crisis. He states that the perception of crises may ultimately affect crisis outcomes. Furthermore, the perception of a crisis as an opportunity or a threat may also have significant implications. Crises are not inherently good or bad; they are merely perceived by most as bad.

Booth⁸ describes crisis as “a situation faced by an individual, group or organisation which they are unable to cope with by the use of normal routine procedures and in which stress is created by sudden change.”

According to David Beirman⁹, “A crisis is a situation requiring radical management action in response to events beyond the internal control of the organisation, necessitating urgent adoption of marketing and operational practices to restore the confidence of employees, associated enterprises and consumers in the viability of the destination.”

J. Spengler¹¹ suggested that “A crisis is an emergency or significant critical event that must be planned for proactively and can often be dealt with by the affected organisation.”

If talking about crisis in very narrow sense and with natural feelings it also called “Impulsive Crisis”¹².

“Crises” can also be described as the possible but unexpected result of management failures that are concerned with the future course of events set in motion by human action or inaction precipitating the event. Events of this type include the Foot and Mouth outbreak on UK farms in 2001, the Chernobyl Disaster and the Exxon Valdez oil tanker wreck¹³. Examples of crises that may occur at some point in the future include:

- The impact of AIDS particularly in Sub-Saharan Africa and potentially in the Indian subcontinent and the Russian Federation;
- An increase in militant religious fundamentalism;
- Nuclear war in Asia;
- Financial meltdowns including global recession; and
- Terrorism employed to achieve political or religious objectives”¹².

Although we are talking about crisis and tourism now, the concept of crisis research is prevalent in other sectors. As Glaesser states in his book, Crisis was a term initially used with national economics. The various approaches within crisis research can be seen in the following diagram given by Glaesser¹³

	System Oriented Approaches	Decision oriented Approaches
Individual Models	<p>Medicine: Turning point is the decision between life and death during the course of an illness</p> <p>Psychology: Perception of an occurrence or situation as an intolerable difficulty which exceeds a person's resources and coping mechanisms. Failure of behavioural patters Danger of identity loss</p>	Individual cognitive problem solving qualities of decision makers in crisis situation
Collective models	<p>Social sciences Crises as phenomena of societies endangered national interest during conflict due to a threatening escalation towards war (e.g. Cuban crisis) Crisis as phenomena of societal subsystems: Politics real changes to the patterns of political relations (e.g. coup. revolution) Economy exogenous economic shocks, phases of down ward trends in the economic cycle.</p>	Collective decision behaviour in crisis situations

Source: Board on Linde (1994)

Glaesser¹⁴ defines crisis as an undesired, extraordinary, often unexpected and timely limited process with ambivalent development possibilities. It demands immediate decisions and counter measures in order to influence the further development again positively for the organisation (destination) and to limit negative consequences as much as possible.

A crisis situation is determined by evaluating the seriousness of the occurring negative events, which threaten, weaken or destroy competitive advantages or important goals of the organisation.

Term crisis is often used along with disaster. There have been many attempts to define both separately as different entities whereas at times they have been used collectively or may be as synonymous.

1: CRISIS / IMPULSIVE CRISIS IN AN ORGANISATION¹⁷:

The word 'Impulsive' means proceeding from natural feeling or impulse without external stimulus and if we talk in terms of organization then the discussion of crisis is done and its recovery is required to be made, then the important parameter is to identify the damage shape of the crisis. That is called 'Impulsive crises'. This study is limited to impulsive crisis only.

When the damage due to crisis has taken place, it is essential to evaluate the amount of the total damage. The recovery will need to know the value of damage and the new state of the working of an organization. Siomkos, George (1992)¹⁵ describes that recovery of the damage done by the crisis is

exponential in terms of time and money.

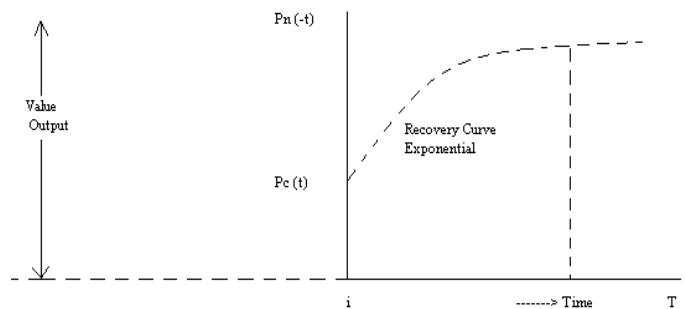
2: IMPULSIVE CRISIS AND ITS EVALUATION: -

The impulsive crisis damages suddenly, and brings down the production or its money value from its normal value to new low value. Followings some are the major causes for the impulsive crisis¹⁹:

- Outbreaks in the organization.
- Employees' sabotage/terrorist attack.
- Fire explosions and chemical spills.
- Sudden drop in revenue/ Market rate of the shares.
- Shortage in raw materials/oils/fuel.
- Natural disaster.

The impact of above happening does impulsive crisis and let the value of organization produce at any time t is $P_n(t)$. Consider the crisis occurs at any time say t , then the value at time $[-\Delta] = P_n(t)$. After the crisis, the value at time $[+\Delta] = P_c(t)$. The fall of the value of the organization output is shown in figure-1.

Figure- (1) Happening of crisis & instantaneous application of remedial recovery



RECOVERY CURVE FROM CRISIS^{10, 21}:

The recovery curve is determined by applying analogy of charging of condenser. The value of the output of the organization between time Δ and T is expressed by the equation:

$$P_c(t) = [P_n(\Delta) - P_c(\Delta)] * (1 - e^{-t/k}) \quad \dots \dots (2)$$

Where,

$P_c(t)$ = value of organization after the crisis at any time t , where $\Delta < t < T$.

$P_c(\Delta)$ = the organization value at the instance of maximum damage.

$P_n(t)$ = the normal value of the organization before the occurrence of the crisis.

K = crisis recovery constant

The recovery crisis constant is important parameter to get rid of the damage of the crisis. This depends on many factors such as²⁴:

- Money employed to replace damage it ever and for paying charges of repairs if any.
- Skilled people carrying out the repair job if any
- Items availability to replace the broken item.
- Availability of cranes etc for picking and fitting

5. M/c shops , welding , shaping, cutting , machinery etc if required
6. Fast supply of raw materials
7. Alternative electricity supply

All these factors decide the value of crisis recovery constant. In general if the value of 'k' is small, then recovery from the crisis will be fast. Then we can say that the crisis management time is inversely proportional to the value of k.

Crisis Management Time $\propto (1/k)$

..... (3)

The above proportionality leads to;

1. Management is excellent if $0 < k < 0.5$ (3.1)
2. Management is good if $0.5 < k < 1$ (3.2)
3. Management is average if $1 < k < 5$ (3.3)
4. Management is poor if $5 < k$ (3.4)

4: ESTIMATION OF DAMAGE DUE TO CRISIS 27, 28:

There are two possibilities to estimate the damage when crisis recovery is exponential and the recovery process is envisaged in equation (2). The first case when recovery starts just after the happening of impulsive crisis, the other case will be when there is some constant delay in starting of recovery .The damage due to either case is studied as;

4.1: When recovery starts immediately after the crisis:

The figure-2 shows graphically the damage caused by impulsive crisis and immediately starts of exponential recovery.

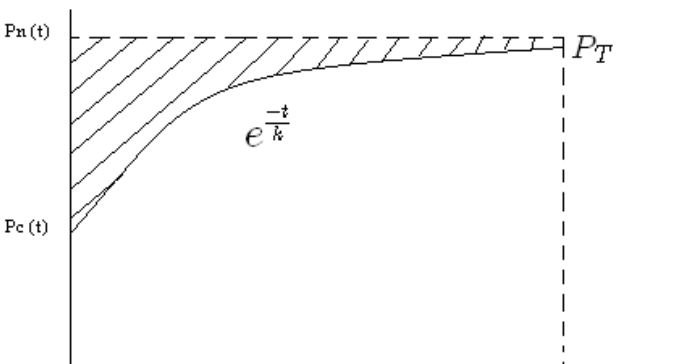


Figure- (2) Shaded area describes the damage.

The hatched area will be the damage caused by the crisis up to time T. Let damage is denoted by Di, then

$$(Damage)D_i = \int_0^T [P_n(t) - P_c(t)] e^{-t/k} dt \dots\dots(4)$$

Where, Pn(t), Pc(t), T and k are known then the damage can be computed.

* This computation has been done by an example in case study portion.

4.2: Estimation of Damage when recovery starts after

delay:

The graphical representation with delay recovery from the damage due to crisis is shown in figure (3).

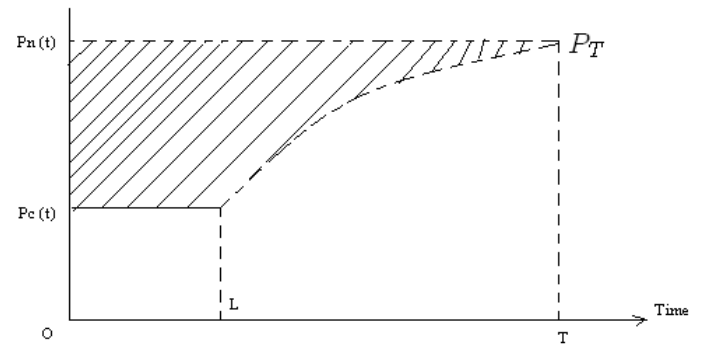


Figure- (3) Shaded area describes damage due to delay in start of recovery

The damage with L time starting late the recovery due to crisis is let given by DL. Then DL is given by the following expression:

$$DL = [P_n(t) - P_c(t)] * L + \{ P_n(t) [T - L] - (P_n(t) - P_c(t)) * L \} \int_0^{T-L} [1 - e^{-t/k}] - (T - L) * P_c(t) dt \dots\dots(5)$$

We hereby plan to compute the damage.

* This computation has been done by an example in case study portion.

**The output values of the organization after remedial services provided,

$$Pr(t) = P_c(t) + [P_n(t) - P_c(t)] * [1 - e^{-t/k}]$$

5: Example:

For the following given data in an organization: Calculate-

- (1) Output value at different times.
- (2) Total damage due to crisis.

 - Normal output per unit time = Pn(t) = 750(Lac.)
 - Fall in output due to crisis = Pc(t) = 350(Lac.)
 - Delay in providing recovery service = L = 5(Unit time)
 - Let the value of recovery constant = k = (.5 to 2.5)

Solution:

The output values of the organization after remedial services provided

$$\begin{aligned} Pr(t) &= P_c(t) + [P_n(t) - P_c(t)] * [1 - e^{-t/k}] \\ &= 350 + [750 - 350] * [1 - e^{-t/k}] \\ &= 350 + 400 * [1 - e^{-t/k}] \\ &= 750 - 400e^{-t/k} \end{aligned}$$

Let, k = .5, 1.0, 1.5, 2.0, 2.5

The, value calculated for Pr(t) are tabulated in the following tables

Solution:

The output values of the organization after remedial services provided

$$\begin{aligned}
 &= P_r(t) = P_c(t) + [P_n(t) - P_c(t)] * [1 - e^{-t/k}] \\
 &= 350 + [750 - 350] * [1 - e^{-t/k}] \\
 &= 350 + 400 * [1 - e^{-t/k}] \\
 &= 750 - 400e^{-t/k}
 \end{aligned}$$

Let, $k = .5, 1.0, 1.5, 2.0, 2.5$

The, value calculated for $P_r(t)$ are tabulated in the following tables

Table 1: $k = .5$

S. No.	t	$P_r(t) = 750 - 400e^{-t/k}$
1	0.5	602.88
2	1.0	695.86
3	1.5	730.08
4	2.0	742.68
5	2.5	747.31
6	3.0	749.01
7	3.5	749.64
8	4.0	749.86
9	4.5	749.95
10	5.0	749.98

Table 2: $k = 1.0$

S. No.	t	$P_r(t) = 750 - 400e^{-t/k}$
1	0.5	507.39
2	1.0	602.85
3	1.5	660.74
4	2.0	695.87
5	2.5	717.16
6	3.0	730.09
7	3.5	737.92
8	4.0	742.67
9	4.5	745.55
10	5.0	747.30

Table 3: $k=1.5$

S. No.	t	$P_r(t) = 750 - 400e^{-t/k}$
1	0.5	462.44
2	1.0	543.25
3	1.5	602.84
4	2.0	644.20
5	2.5	673.94
6	3.0	695.86
7	3.5	711.08
8	4.0	722.02
9	4.5	730.08
10	5.0	735.68

Table 4: $k = 2.0$

S.No.	t	$P_r(t) = 750 - 400e^{-t/k}$
1	0.5	438.48
2	1.0	507.38
3	1.5	561.05
4	2.0	602.84
5	2.5	635.39
6	3.0	660.74
7	3.5	680.49
8	4.0	695.86
9	4.5	707.84
10	5.0	717.16

Table 5: $k = 2.5$

S.No.	t	$P_r(t) = 750 - 400e^{-t/k}$
1	0.5	422.50
2	1.0	481.87
3	1.5	530.47
4	2.0	570.27
5	2.5	602.84
6	3.0	629.52
7	3.5	651.36
8	4.0	669.24
9	4.5	683.88
10	5.0	695.86

A STUDY ON CRISIS ANALYSIS BASED ON CRISIS IN DEPARTMENTS OF AN INDUSTRY

1. Total Crisis based on Crisis in Departments with the help of Boolean algebra^{22, 25}:

Whenever we talk of management the essential need is to quantify the cause, which becomes the reason of crisis. If this cause is replaced or reinforce the crisis is over.

The main constituents/ Departments of any organization are^{26, 29}:-

- Human Resource department
- Marketing department
- Production department
- Information Technology department

If crisis occurs in any department, the situation may as given below-

- Human Resource Crisis = Hc
- Marketing Crisis = Mc
- Production Crisis = Pc
- Information Technology Crisis = I-c

If we consider these as variables, then they assume values either ONE or ZERO, representing whether crisis representing whether crisis exist or not.

If we calculate the departmental crisis with the help of BOOLEAN ALGEBRA, we can calculate the total crisis. If the study carried out mathematically, then these can be a theorem stating the situation of the organization given as below.

THEOREM: - If there exist a crisis in any constituent, the entire system suffered with crisis.

Proof: - Let the constituent variables are represented as,

- Human Resource Crisis = Hc
- Marketing Crisis = Mc
- Production Crisis = Pc
- Information Technology Crisis = I-c

The possible crisis evaluation using BOOLEAN ALGEBRA can be given as,

$$\text{Crisis 'C'} = H\bar{c} + Mc + Pc + Ic + Hc.Mc + Hc.Pc + Hc.Ic + Mc.Pc + Mc.Ic + Pc.Ic + Hc.Pc.Ic + Hc.Mc.Ic + Mc.Pc.Ic + Mc.Hc.Pc.Ic \dots (1)$$

In the Equation (1), Plus Sign (+) represents OR & Dot Sign (.) represents AND of BOOLEAN ALGEBRA. Whenever a crisis occurs in any variables the value of the variables is ONE, otherwise it is ZERO.

If C = 1, Means there is a crisis in the system. Hence we have to find the value of 'C' equal to ONE. If & if any variables is equal to ONE,

Consider that Hc = 1. This makes the equation.

$$C = 1 + Mc + Pc + Ic + 1.Mc + 1.Pc + 1.Ic + Mc.Pc + Mc.Ic + Pc.Ic + 1.Pc.Ic + 1.Mc.Ic + Mc.Pc.Ic + Mc.1.Pc.Ic.$$

$$C = 1 + Mc + Pc + Ic + Mc.Pc + Mc.Ic + Pc.Ic + Mc.Pc.Ic$$

[In Boolean algebra A.A = A]

A]

And in Boolean algebra

$$1 + X = 1$$

Where, X = 0

Or X = 1

Then,

$$C = 1 + Mc [1 + Pc + Ic + Pc.Ic] + Pc [1 + Ic] + Ic = 1 + [Mc + Pc + Ic] = 1$$

$$C = 1$$

- If crisis occurs in two departments like Hc & Pc.

$$C = 1+1+ Mc + Ic + Mc + 1 + Ic + Mc + Mc Ic + Ic + Mc + Ic + Mc Ic+ McIc. = 1 + [Mc + Ic] = 1 + X$$

Where, X = [Mc + Ic]

$$= 1$$

$$C = 1$$

The 'C' again equal to ONE it means there is a crisis in the organisation.

When ever there is any crisis in any constituent of the system. It will lead to a crisis on whole. It can be seen that crisis always causes a loss, which can be evaluated as given in next section.

2. Loss Estimation due to Crisis^{23,30}:

It is a lifetime of crisis, which affects the loss of the system. A short duration crisis leads to affordable loss while long duration crisis makes the system. A short duration crisis leads to affordable loss while long duration crisis makes the system sick & many time losses becomes so heavy who leaves no alternatives accept to close the organization^{2, 3}. The leading example in India, Uttar Pradesh particularly is 'UPTRON LTD.' which has been closed recently.

Following describes losses of organization as given below-

1. We here by consider that the organization was in crisis for number of days equal to 'm' days.
2. The production losses for 'm' days if the rate per unit is 'x' and quantity produced is 'y'.
= x.y.m
3. 'm' days employs are paid the salary loss. If per day payment of employs comes out to the 'z'.
Salary loss = m.z
4. The electricity and water payment. If it is 'w', then the loss will be
= w.m
5. If rent / space loss. The entire organization unnecessary occupied the space
Without doing any work. This will amount rent loss 'v' Rs / day.
= v.m
6. Security loss, the organization has to pay per day extra for security say equal to Rs 's' / day.
= s.m
7. Unforeseen losses are = k.

The total loss due to crisis will be the summation of all these and will be expressed as.

$$z + w + v + s) + k \quad \text{Total Loss} = [m(x.y + \text{western}'' 2001$$

Where, m = number of days.
& k = unforeseen losses.

6: CONCLUSION

The sudden occurrence of crisis termed impulsive crisis has been studied. A mathematical model in terms time and money are developed for the estimation of damage loss of the organization for instantaneously start of recovery and the recovery starting late. The results of case studies are tabulated in the study. The study will proved guidelines for the quantities estimation of any crisis in any organization.

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