



ON THE LINK BETWEEN FUTURE STUDIES AND NECESSITY OF INCLUDING CORROSION IN A “DESIRED FUTURE” SCENARIO: PRESENTING A MODEL

Reza Javaherdashti *¹, Farzaneh Akvan ^{1,2}

¹ Corrosion Studies Monitoring Centre, Shakhspajoo (Future Studies) Research Institute, Isfahan, IRAN

² Arya – SGS inspection company, Tehran, IRAN

Abstract:

In this paper a model is developed to address how a bad, man-made incident such as corrosion as an element for moving from a possible future to a desired future must be handled within a Participatory Action Learning scheme. The possible mechanisms (including corrosion knowledge management as a managerial tool) are also addressed and discussed.

Keywords:

Corrosion; Corrosion knowledge management (CKM); Possible and desired Futures; Participatory Action Learning.

Cite This Article: Reza Javaherdashti, and Farzaneh Akvan, “ON THE LINK BETWEEN FUTURE STUDIES AND NECESSITY OF INCLUDING CORROSION IN A “DESIRED FUTURE” SCENARIO: PRESENTING A MODEL” *International Journal of Engineering Technologies and Management Research*, Vol. 2, No. 4(2015): 1-8.

1. INTRODUCTION

“Corrosion” is a familiar terminology to industry professionals working in oil & gas, power generation, aviation, marine-offshore, mining, chemical and water/waste water treatment industries, to name a few. Economists and feasibility study professionals mostly use “Depreciation” and “wear and tear” instead of corrosion-though it is not a correct terminology to cover all aspects of corrosion. The man-on-the-street knows corrosion by yet another name: rusting. All these variations could only mean one thing: the confusion and ambiguity that does exist in addressing an “issue” that on its own takes away about 4% of Gross National Product (GNP) of any country per year [1] or even more [2]; an “issue” that on its own annually costs humanity much more than all natural disasters all together [3,4] and an “issue” that, to the best of our knowledge, has not been studied in the context of Future studies research ,yet.

In this paper, we will study the importance of corrosion in terms of defining possible future scenarios and how this importance must be addressed within this context.

2. METHODOLOGY

1. “Possible” and “Desired” Futures:

In the context of this paper, it is essential to distinguish between two very important concepts, the concepts of “possible” and “desired” future scenarios. What is meant by “possible future” is a future in which both “good” and “bad” incidents can exist together. However, a “desired” future will be the one in which the ratio (possibility) of “good” incidents will be minimised with respect to the “good” incidents. Figure 1:

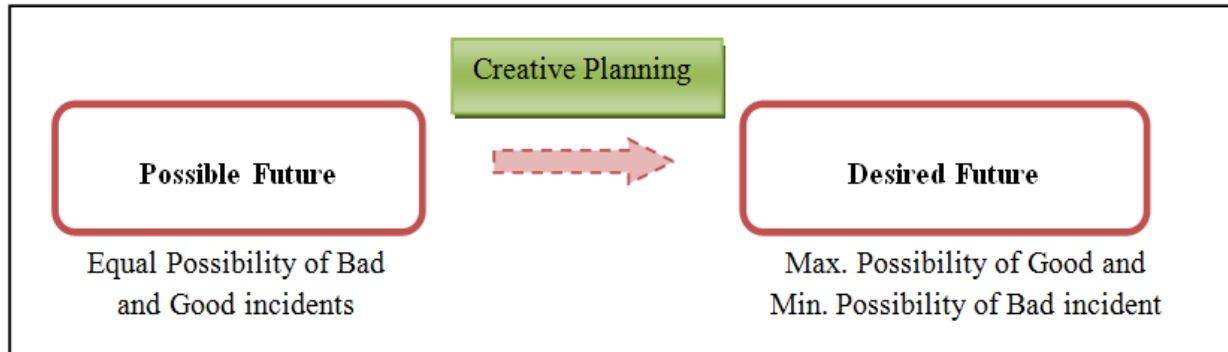


Figure 1: Possible and Desirable Futures

In the “possible future”, it is of equal probability to come across incidents that can be labelled as “bad” and can be defined as incidents that minimise our profits and maximise our loss. Likewise, “good” incidents are those that maximise our profits and minimise our loss. Further, if we focus on bad incidents, we can think of bad incidents whose main characteristic is that their risk cannot be assessed. Such bad incidents can alternatively be called as “Natural Disasters”. As we mentioned a few lines earlier, when we brand these incidents as: bad”, we have no intention to brand them as such from either a theological or moralistic viewpoint; they are bad simply because when they occur, the immediate result we, as humans, observe is the economical loss they cause.

Apart from natural disasters, one can also think of bad incidents whose risk is calculable and assessable. These bad incidents can be called as “Human-made” bad incidents. A good example of such incidents is Corrosion, Figure 2:

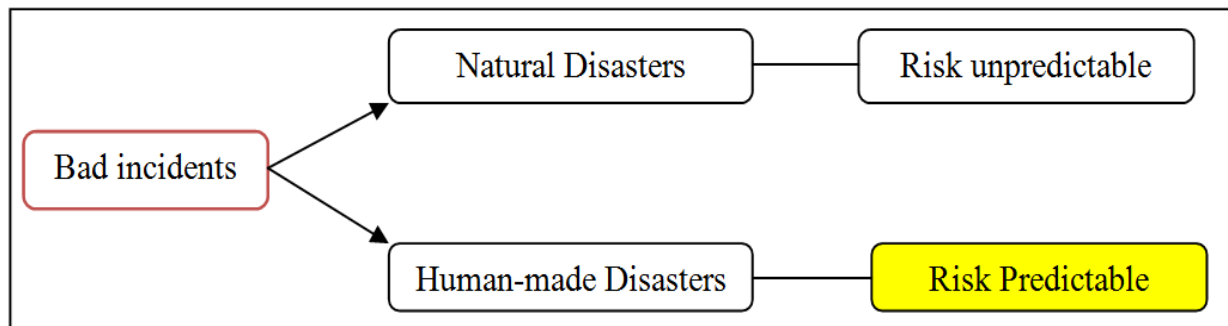


Figure 2: Classification of bad incidents into Natural disasters and Human –made disasters

In the definition so far both classes of bad incidents, we introduced a very important concept of “Risk”. When it comes to Risk, one has to be careful and that is why we will explain it, as pertinent to corrosion, in a separate section below. We will also introduce the important concept of “Engineering Importance”.

3. FINDINGS

Concepts of “Risk” and “Engineering Importance” and their role in arriving at a desirable Future related to corrosion:

We said that one very important measure of arriving at a desirable future, is to decrease bad incidents and one of these bad incidents is corrosion. Corrosion is a man-made bad incident whose Risk can be calculated - contrary to natural disasters whose Risk cannot be calculated. But what is Risk?

Engineering Risk:

Engineering risk or risk as an Engineering concept, While a “risky” business has a relative meaning, that is to say, the “riskiness” of a business may differ from person to person or from situation to situation, “Risk” has a definite engineering meaning that is shown below as equation(1):

Risk of a Hazard = Likelihood of a Hazard × Consequences of that Hazard (1)

Normally, Risk is defined in a Risk matrix an example of which can be seen in Figure 3:

RISK ASSESSMENT						
		CONSEQUENCE				
		LOW	MINOR	MODERATE	MAJOR	CRITICAL
LIKELIHOOD	ALMOST CERTAIN	High (11)	High (16)	Extreme (20)	Extreme (23)	Extreme (25)
	LIKELY	Moderate (7)	High (12)	High (17)	Extreme (21)	Extreme (24)
	POSSIBLE	Low (4)	Moderate (8)	High (13)	Extreme (18)	Extreme (22)
	UNLIKELY	Low (2)	Low (5)	Moderate (9)	High (14)	Extreme (19)
	RARE	Low (1)	Low (3)	Moderate (6)	High (10)	High (15)

Figure 3: An example of a Risk Assessment Matrix

As seen from Figure 3, the likelihood of a given hazard (e.g. Corrosion) is graduated in five categories and so are its consequences. If the possibility (likelihood) of corrosion hazard in a plant is classified as “Unlikely” but its consequences are “Critical” should it happen, its Risk is to be classified as “Extreme”. Routinely, Risk-based inspections (RBI) and other integrity management techniques help collect the raw data needed to construct such matrices, These data normally via in-house integrity management softwares are calculated and based on that not only different Risk categories (Low, moderate, High and Extreme) are defined, but also each of these categories is further sub-classified (e.g. Low (1) and Low (4)). This way the Risk of corrosion can be estimated in a plant. Obviously, this is not just for corrosion but any hazard as such.

Engineering Importance:

Engineering Importance or briefly importance, is an important measure that allows us classifies bad incidents. If a bad incident has a higher importance, it can be taken as priority compared to a case whose importance is lower. The most important feature of importance is that it can be used as a communication tool between both engineers and economists. The reason is that Engineering Importance can be defined as in equation (2):

$$\text{Engineering Importance} = \text{Risk} \times \text{Cost} \quad (2)$$

Risk, as one of the components of importance, cannot explain importance alone: Risk has an engineering meaning that if not translated into cost, it cannot raise awareness for a manager who has no engineering training in, say, corrosion: everyone who has worked in industry appreciated that Risk of corrosion is indeed very serious. Some cases have been explained in reference [5]. However, all these bad incidents just remain as “bad memories” if financially not investigated. This is where the very important factor of “cost” comes into the picture: if Risk serves to think engineers twice, it is the cost associated with the Risk that says the last word in a world that money counts. Applying Engineering Importance to corrosion results in understanding not only the Risk of corrosion but also the cost of it, both in terms of economy and ecology. Next section will briefly review some cases where corrosion has been a source of both Risk and high cost.

4. DISCUSSIONS

Engineering Importance of Corrosion: Cost

While economical cost of corrosion can be categorised into Direct and Indirect costs, its overall costs goes beyond just its economical importance and can be expressed as both ecological and energy loss [5]. Figure 4 shows this classification with more details:

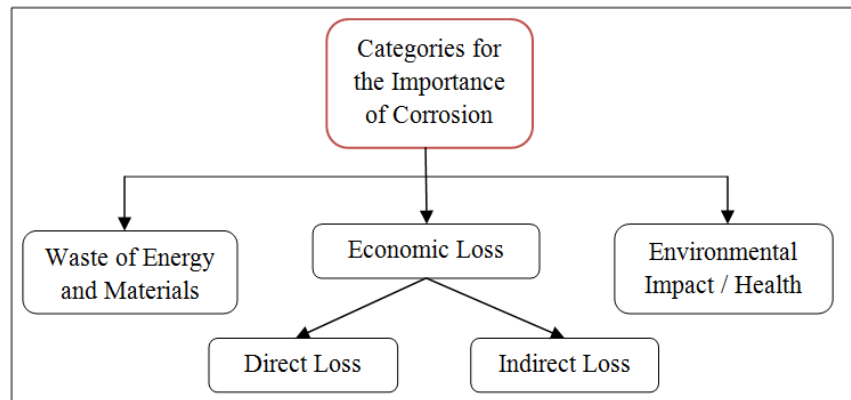


Figure 4: Classification of Corrosion Costs

Table 1 lists some of the relatively recent issues occurring around the world related to corrosion. For more case s see references [6, 7]

Table 1: Some Examples of Corrosion related disasters from around the world

Year	Country/ Place	System/ Equipment	Cause/ Consequences
May 2015	USA/Santa Barbara Coast, CA	Oil Pipeline Operated by Plains All Americans	Most probably severe corrosion/ Spill of more than 100,000 gallons (more than 300,000 Litres) of crude oil into the coast, Environmental as well as economical costs
November 2013	China/ Qingdao	Oil Pipeline owned by Sinopec	Corrosion/ The blast killed 62 people and injured 136, stoppages in electricity and water in nearby areas. About 18,000 people were evacuated. The Sinopec pipeline explosion caused a direct economic loss of 750 million Yuan (\$124.9 million). Fifteen people, including unspecified numbers of

			Sinopec employees and Qingdao city staff, have been detained in connection with the explosion.
2012	France	Hydrodesulphurization unit	The leak was probably due to corrosion from exposure to hydrogen sulphide
2012	Spain	Process Pipe	A fire occurred in the fluid catalytic cracking unit of an oil refinery due to a leak in the pipe.
2012	USA	Pipe	The catastrophic failure of the pipe in the crude oil distillation unit released flammable substances and produced a large vapour cloud that spread to the off-site community.

As seen, corrosion is a highly costly bad incident whose risk can be calculated. This way, its importance is also accountable. The next section will discuss briefly about management of corrosion.

Corrosion Knowledge Management:

Any corrosion-related problem can be looked at from two points of view: technical and managerial viewpoints. The technical approach, which is widely known as corrosion management (CM) tries to control the risk of corrosion. However, corrosion knowledge management (CKM) looks at pulling down the costs associated with corrosion. While CM is a technical approach, CKM is mainly discussing about managerial concerns that are mainly focused on the manager's resources.

CKM has been the topic of some papers and workshops on an international level by this author [8-10] for the last 20 years or so. The emphasize in all these activities has been on building up a result-driven understanding among corrosion professionals and managers who may have had limited technical knowledge about corrosion and its significance.

Future Studies and Corrosion:

By looking at different types of Future studies, one may safely assume that studying corrosion within this context is an example of "Participatory Action Learning" where the aim is "*To develop probable, possible and preferred estimations of the future based on the categories of stakeholders The future thus becomes owned by those having interests in the future*". [11]. in this context, corrosion engineers as well as policy-makers must participate in the desired future in which the impact of corrosion as a bad incident is minimised. Some of the methods by which this participation can take place are explained in Figure 5:

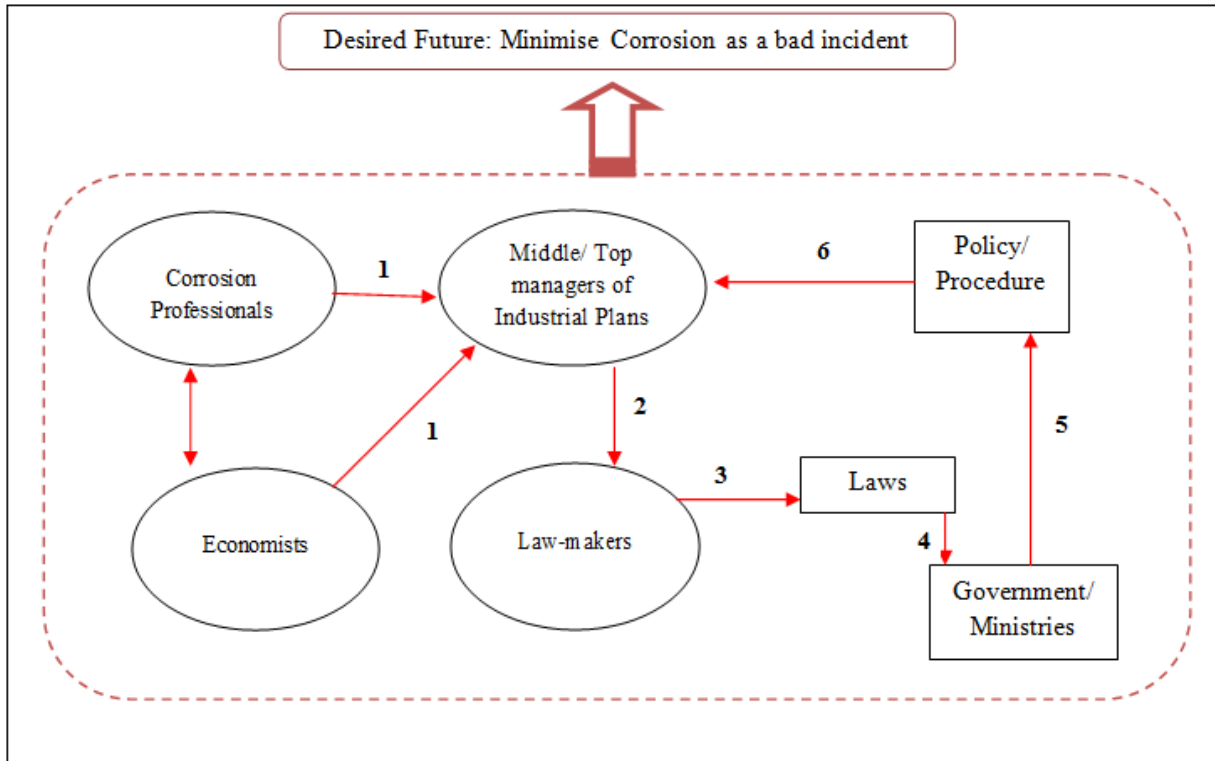


Figure 5: Six paths to move towards a desired future with minimised corrosion bad incident

After Both corrosion professionals (Engineers/Technicians) and Economists through interactions with each other come to an idea about costs of the corrosion (Economic models) and its Risks, they will try to reach out to other segments which are all located in the present box via the six main paths as shown in Figure 5 can be explained as follows:

1. Corrosion professionals and economists will communicate with the manger of industrial units via corrosion knowledge management (CKM). This communication/interaction will be in the form that managers will understand and appreciate the cost of the corrosion (both economical and ecological as well as legal costs) of corrosion. Middle and Top managers need not to know the technicalities involved in managing corrosion because it is the task of the corrosion professionals. Neither do they need to know the details of economical models. All managers need to know is to have been convinced that one must do something,
2. The top managers, based on the hierarchy, political lay out and other influencing factors that may affect their efforts officially (or unofficially) will approach the law-makers. The lobbies with law makers must be of a nature that more than being technical, it is based on facts and figures.
3. As results of these lobbies, laws will be passed so that taking care of corrosion will go beyond just-technical activities and will become a management challenge as well as an engineering one.
4. These laws will be implemented by government bodies and authorities. In this way, the administration will have a platform upon which based on their line of duties, rules and regulations will be defined for managing corrosion.
5. Policies thus defined will be in accordance with the needs and line of duties as per the governments general policies Therefore management of corrosion within Ministry of Petroleum

will be different from what to be applied within the Ministry of Health (corrosion of body implants and their health consequence for example).

6. By Top and Middle managers obligation to implement the rules and regulations dictated upon them by their upper hand authorities, the loop will be closed. This way, every time there is a need for any improvement, through steps 1 and 2, the required changes will be studied in details and suggested. The rest will continue as per steps given above.

This way, the whole body of the society will be moving towards a desired future within which the risk of the bad incident of corrosion is calculated and lowered within stages that can later be prepared within a written all-compassing governmental policy for controlling corrosion in all of its aspects and within all sectors where it is seen as a need.

5. CONCLUSIONS

According to Kosow and Gaßner “A scenario can be defined as a description of a possible future situation,” including the path of development leading to that situation” [12]. In this paper a model for Future studies the revolves around a specific technical problem (corrosion) is presented for the first time. Within this model, in order to shift from a possible future scenario to a desired future scenario, the probability of man-made bad incident of corrosion whose risk can be foreseen is lowered. This model is an example of Participatory Action Learning and is based on collaborative interactions of those entire have an interest in it, mainly industries. Possible mechanisms for such collaboration are also explained briefly.

6. REFERENCES

- [1] Heitz E, Mercer AD, Sand W, Tiller AK (eds). *A Working party report on microbiological degradation of materials and methods of protection, England, 1992.*
- [2] Sastri V. S., *Challenges in Corrosion: Costs, Causes, Consequences, and Control, John Wiley & Sons, USA, 2015.*
- [3] Guha-Sapir D., Hoyois Ph., Below R., *Annual Disaster Statistical Review 2013, 2014.*
- [4] G2ME Laboratories, <http://www.g2mtlabs.com/2011/06/nace-cost-of-corrosion-study-update/>, visited March 2015.
- [5] Javaherdashti R., Nwaoha C., H Tan, *Corrosion and Materials in Oil and Gas Industries*”, published by CRC Press/Taylor & Francis, USA, 2013.
- [6] Wood MH., A-l Vetere Arellano, Van Wij L., *Corrosion-Related Accidents in Petroleum Refineries: Lessons learned from accidents in EU and OECD countries, European Commission Joint Research Centre Institute for the Protection and Security of the Citizen, EUR 26331 EN, 2013.*
- [7] http://www.huffingtonpost.com/2015/06/03/pipeline-that-spilled-oil_n_7507030.html, visited on 28 June 2015
- [8] Javaherdashti R., *Using Corrosion Management to Protect the Environment, Materials Performance (MP), 2006, 45(6).*
- [9] Javaherdashti R., *Managing corrosion by Corrosion Management: A guide for industry managers, Corrosion Reviews, 2003 .21(4).*
- [10] Javaherdashti R, *How to Manage Corrosion Control without a Corrosion Background, Materials Performance (MP), 41 (3), 2002.*

- [11] Inayatullah S., *Futures Studies: Theories and Methods*, <http://www.wfsf.org/resources/pedagogical-resources/articles-used-by-futures-teachers/90-inayatullah-futures-studies-theories-and-methods-published-version-2013-with-pics/file> , visited July 2015.
- [12] Kosow H., Gaßner R., *Methods of future and scenario analysis: Overview, assessment, and selection criteria*, DIE Research Project “Development Policy: Questions for the Future”, Dt. Inst. für Entwicklungspolitik, 2007 – (Studies / Deutsches Institut für Entwicklungspolitik; 39, ISBN 978-3-88985-375-2Bonn 2008.