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Human error and successful project management in two construction companies

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ABSTRACT

Based on the framework of the Rasmussen model, this research focused on establishing a relationship between human error and project success to execute error detection, particularly concentrating on the causes associated with the project development systems and practices used.

The applied research involved a strategic sample of two companies, 14 projects under execution and 68 stakeholders playing different roles in projects. Therefore, documentary evidence and stakeholder perceptions were collected through surveys and semi-structured interviews to assess the occurrence of human errors and their impact on project success regarding time, scope, cost, quality and management. Furthermore, the Rasmussen model and its supporting analysis tools were implemented to foster decision-making and cognitive processes.

Results indicated that the research successfully identified root causes of the error and their relationship with automation-based decision-making and defined compliance with rules or previous knowledge and means of preventing or defending from them.

Keywords: Human Error, the Rasmussen model, Project Management, Knowledge Management, Engineering Management

1 INTRODUCTION

In general, companies must guarantee adequate resource and time distribution and management to comply with established scopes, anticipate issues or deviations that could exert a negative impact. They should also make timely changes and adjustments that can contribute to the success of the projects being managed within their organisation. Consequently, companies are constantly exploring new methodologies and tools to verify whether the processes inherent to each project's lifecycle rigorously fulfil their strategic objectives.

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Thus, they adopt methodologies and good practices to better respond to customer needs, sustaining service quality levels and delivering comprehensive solutions to strengthen customer loyalty.

The project operation dynamics or the constraints in recording any lessons learnt do not always allow for a rigorous root cause analysis of human errors. These limitations are more pronounced whenever the importance of assessing the excessive cognitive demands from work is underestimated. Hence, rule compliance may lead to competent but unconscious actions or insufficient practice toward developing skills and abilities required for an adequate performance.

Human error can become an invaluable learning and change mechanism, provided that the organizational procedures and cultural maturity exist that allow them to be identified, evaluated and strategies designed to remove the behaviours and restrictions that make up obstacles.

Errors lead to defects, which are basically deviations from the original plan, and should be identified and analysed through risk probability assessment techniques and cognitive models framed within cognitive ergonomics. Therefore, error identification has become crucial for successful project management.

The International Ergonomics Association (IEA) [1] defines cognitive ergonomics as a scientific discipline 'concerned with mental processes, such as perception, memory, reasoning and motor response, as they affect interactions among humans and other elements of a system'. It is an area of ergonomics with applications in any field of industry and type of organisation.

An application area of cognitive ergonomics is the analysis, prediction and mitigation of human errors. Human error is understood as the sequence of mental and physical activities that fail to achieve their intended outcome when these failures cannot be attributed to the intervention of a random agent [2]. According to the author, errors can be described in terms of slips, negligence and lapses possibly resulting from recognition failures caused by mistakenly identifying objects, signals or messages that were not detected or instead wrongly perceived, in addition to memory and attention failures and interference errors.

The conducted research reinforces the foundations of a work culture, where project teamwork, new forms of interaction with stakeholders, more direct communication

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channels and a preventive approach to error management are distinguished as effective mechanisms for improving knowledge and change mindset and attitudes. This can be achieved by managing and preventing the repetition of these mechanisms, thus enhancing the importance and benefits of knowledge management.

The human factor is constantly considered for determining the success or failure of any project. 'One of the key success factors in business competitiveness, specifically in the fields of applied research and engineering projects, has been and is the development of human skills based on the intensive use of the acquired knowledge and expertise on project management' [3]

Mishra [4] reported that for any company to become successful, it will have to fail a few times and learn lessons from its mistakes. Only then it can flourish as a great company. The value of a mistake lies not in the mistake itself but in what managers can learn from it. Changes are essential for fostering a culture of learning from mistakes within the organisation. There is always enough room for further improving all existing processes and methodologies within the company.

If managers can learn from the mistakes they identify, analyse and attempt to mitigate or eradicate, they will also acquire sufficient knowledge to at least prevent these mistakes from recurring in the future.

Based on the Rasmussen model, this research focused on defining the relationship between human errors and project success in two construction companies to facilitate their detection, assessment and defence system against human errors in project management.

The recorded project success rate is more significant because the number of failing projects is extremely high, with more than a third of the projects reviewed to have failed in achieving their objectives [5]. According to Mir and Pinnington [6], project success is a complex and multidimensional notion that encompasses many attributes. All projects are intrinsically unique, implying that project success criteria differ from one project to another [7].

Further, Kerzner [8] argues that projects delivered on time, within cost and fulfilling the performance requirements can be rendered profitable, but we could still fail to identify whether the project itself was properly managed.

Although we are still unable to comprehensively sort the error causes affecting the fulfilment of project objectives in an organised manner, the importance of accessing knowledge associated with multifactorial error causes is undeniable because it contributes to developing appropriate and timely strategies.

The leadership and managerial skills of project managers are tested when stakeholder management and communications are strengthened to introduce human error-based management. Within this context, knowledge management becomes a priority and processes focus on improving error knowledge and changing employee mindsets, which will not only consolidate proactive management but also gradually and intentionally transform culture. Adopting a new mindset will allow project managers to foster greater collaboration and motivation, thus implementing changes more rapidly, prompting stronger leadership and nurturing better engagement from all stakeholders, as well as enforcing best management practices, improving attitudes, encouraging a resilient mindset and strengthening commitment from all project team members.

Within this context, poor cost and time estimates during the project planning phase are among the main causes contributing to weak project performance upon implementing project management within an organisation [9]. **See Figure 1.**

The predictive or classic approach to project management, where the product and deliverables are defined at the beginning of the project, in addition to showing its greatest weaknesses in the planning process when trying to overcome uncertainty, is mostly weak to allow learning from mistakes. at any moment of its development, which opens up great opportunities to introduce the analysis of human error, as a way to improve estimation processes and knowledge-based decision-making.

This research focused on establishing a relationship between human error and project success to execute error detection, particularly concentrating on the causes associated with the project development systems and practices used, according of the Rasmussen model where discriminating actions based on automation, rules, and knowledge.

The paper is structured as follows: Section 2 explains the literary review, specifically the Rasmussen model. The Section 3 presents the research methodology. Section 4 presents the results of the research. Section 5 gives a findings discussion. Section 6 concludes the paper.

2 LITERARY REVIEW

2.1 THE RASMUSSEN MODEL

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According to Rasmussen [10] and from a standpoint of knowledge engineering, the cognitive processes conducted for information processing and decision-making must be structured in eight stages or steps, as denoted in **Figure 2**.

According to the stage path identified in Figure 2, if behaviour is particularly automated, the person directly moves from the activation and observation stages to the execution stage. However, when the behaviour follows rules and procedures, there will be a shift from the identification stage to the execution stage. Finally, when the behaviour is based on knowledge, the person goes through all above eight stages.

Hence, based on these eight steps, the Rasmussen model states that the behaviour exhibited by people when performing an activity can be classified into three cognitive levels, namely, rule-, automation- and knowledge-based.

For Stock et al. [11], situational cognitive failures, defined as previously thought out and planned actions, contributing to errors could be classified as mentioned below:

- Skill- or performance-based errors (e.g. the plan is acceptable, yet the actions are not performed as planned);
- Rule- or knowledge-based errors (e.g. the actions are performed as planned, yet the plan will not achieve the intended outcome); and,
- Violations or non-compliances (e.g. the industry or organisation-imposed rules or standards).

Herein, the cognitive level does not depend on the task but on the level of experience that the person has for performing such a task. The rule-, automation- and knowledge-based terms refer to the degree of awareness control exercised over activities.

2.2 THE ADVANTAGE OF RASMUSSEN'S COGNITIVE MODEL

The advantage is that it combines the identification of the functional origin of the error (processing stage) with the implied performance level (based on knowledge, rules or automation) and allows separate error treatment stages. Furthermore, the specificity of some errors proposes preventive measures adapted to the level of performance of the person.

A. Rule-based

Rule-based behaviour defines behavioural patterns as combinations of actions based on automatism. These rules were learnt from system interaction, through training or

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working with experienced workers. The level of awareness control is intermediate between the knowledge- and automation-based levels.

B. Automation-based

Automation-based behaviour requires a high level of experience and practise. It is performed through routine activities. An automated response is usually triggered by a specific event; for example, the need to open or close a valve owing to an alarm, a procedure or a direct order from another individual.

C. Knowledge-based

When attempting to solve an unfamiliar problem, the person must engage in knowledge-based behaviour, which exhibits a higher conceptual level. In knowledge-based mode, tasks are performed fully consciously.

According to Dozois et al. [12] any source of error is more likely to arise from a situation perceived as negative from the cognitive perspective, which means that cognitive processes manage positive information better than negative information. Positive information not only leads to better performance but also generates emotion. If the information is positive, the situation becomes pleasant, while if the information is negative, it becomes unpleasant.

Although cognitive errors have been thoroughly described by Ely et al. [13], little is known about how to prevent them.

According to Santiago et al. [14], Rivas [15], Huitt [16], Melamed [17], cognitive processes can be structured as perception, attention, memory, learning, thinking, language, and metacognition.

According to Wang [18], perception is a set of internal sensational cognitive processes of the brain that relates cognitive processes to human perception, emotions, motivations and attitudes; it is the subconscious life function layer that detects, relates, interprets and searches internal cognitive information in the mind.

For Raftopoulos [19], attention is a process in which some inputs are processed faster, better or deeper than others so that they are more likely to produce or influence a behavioural response, even when a bodily response is not strictly necessary. Furthermore, attention limits processing to elements that are relevant to the behaviour. It is a process through which the person filters unwanted information (objects, sounds) to see (hear, feel) the desired information.

Further, Lupón et al. [20] define memory as a psychological process that stores, encodes and records information with particularity that this information can be

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recalled or retrieved to perform subsequent action or provide an answer. It is a characteristic process of humans (although not exclusive) without which no learning can happen.

Learning happens continuously throughout a person's lifetime, thus constituting an inherent characteristic of the person's human nature. That is, learning is typical of humans. Compared with language, learning is an essential property of humans, although without constituting the essence of being human [21].

As claimed by Guarneros [22], thoughts are ideas, memories and beliefs in motion interacting with each other. Thoughts go hand-in-hand with other mental processes related to emotions and are generated and regulated by a part of the brain known as the limbic system. For American Speech-Language-Hearing Association, language comprises conventional social rules that include word meanings, creation of new words, combination of words and word combinations appropriate to each given situation.

Finally, Rivas [15] argues that metacognition is cognition about one's cognition or knowledge about one's cognitive processes. Thus, it is the knowledge that one has about one's knowledge.

According to Frese and Keith [23], any strategy used to learn from errors will prompt at least some of the following four forms of knowledge:

1. Errors lead to knowledge about the error that has occurred; this may help to avoid these errors in the future.
2. Learning is the result of experimentation; in this case, errors lead to exploring the system and, thereby, to a better understanding of the system.
3. Learning includes the development of a mindset on how to deal with errors.
4. To reduce potential frustration that normally appears as a result of errors.

The error management strategy starts after an error has occurred and attempts to block negative error consequences or to reduce their negative impact through design or training [24].

3 Research Methodology

This research study focused on establishing a relationship between human errors and project success in two project-centred construction companies. It is based on the Rasmussen model to improve their project management error detection, assessment and prevention systems, thus relieving the causes

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that generate reprocesses, delays, cost overruns and errors attributable to project management.

According to its purpose, the research was applied research. Further, in addition to describing each situation, the determining causes were assessed and the type of research is both correlational-explanatory and descriptive-explanatory. This research is correlational-explanatory because it assesses the incidence of human error in project success and the relationship between project characteristics and its key variables. Furthermore, it is descriptive-explanatory because it describes each situation, assessing and interpreting variable relationships between variables and obtaining information from various sources that previously documented the subject matter.

The research was limited to working with an intentional sample defined by the total number of projects being conducted at two companies (14 projects). Unlike completed projects or projects still in their planning stages, greater benefits would be reaped by convening the active stakeholders of these projects, who might have learnt more recent lessons and authority to change the course of their projects.

The selected projects were segmented as per their approved budget, as given in **table 1:**

Furthermore, this research assessed documentary evidence of process and objective achievement results, such as time, scope, costs, quality, and management activities. Stakeholder criteria were assessed using surveys, semi-structured interviews and examination and perception of associated factors through the human error analysis model and various tools from the Rasmussen model.

To capture information and assess and identify the root causes related to human errors, the authors interviewed 68 professionals from the two companies, who performed specific functions and roles in the 14 selected projects. Some of these professionals were part of the Project Management Offices (PMO) of both companies, while others were considered internal (project team members, SMEs from functional work areas and project managers) or external stakeholders (clients, contractors). The external professionals that were interviewed were selected based on their professional expertise, relationship with the construction industry and association with the projects selected from each

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company. Hence, the language used did not hinder communication, thus guaranteeing valuable opinions for assessing error causes.

The common instruments used in the research study included questionnaires and semi-structured interviews, which focused on questions that would help us answer one or more variables studied.

These questionnaires and interviews included 12 questions that were applied to stakeholders in focus groups formed based on their individual characteristics and projects in which they participated. Overall, 18 groups were formed with an average of four (4) to five (5) participants per group. Individual interviews were conducted for project managers **(see Table 2).**

Of the 14 project managers, 12 were interviewed. These interviews were supplemented with interviews to another 56 stakeholders for a total of 68 respondents.

The questions included in the questionnaire were the following:

1. How did the project deviate from its objectives throughout its development?
2. Were there any slips, omissions and oversights caused by subconscious acts that could have affected the projects?
3. What kinds of tools were used to manage, analyse, evaluate or avoid oversights or omissions identified in Question 2?
4. What kind of signals or early warning you noticed causing possible deviations in the projects?
5. In the project in which you participated, which processes were affected the most by human errors?
6. Which errors could be openly discussed and managed in the project team?
7. In which of the knowledge areas that define project management could you note human errors?
8. If you could start the project again, what would you change to prevent the same errors?
9. Do you think that any of the project errors was attributable to you?
10. Which errors were caused by poor skills or abilities?
11. Which errors were caused by automation-based actions?
12. Which errors were caused by limited knowledge at the time?

Based on sufficiency, clarity, coherence and relevance criteria regarding each question included in the survey, a pilot test was conducted to validate the instrument, applying a survey to six (6) stakeholders with more experience and direct project responsibilities. The six (6) respondents

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were also included in the total number of people who answered the final questionnaire.

Consequently, our survey items obtained a coefficient of 0.841, which proves that the instrument itself is reliable as per Cronbach [25] and secures its reliability throughout the study. **table 3** shows the dimension analysis.

The research assessed documentary evidence of process fulfilment based on objective achievement results, namely, time, scope, costs, quality and management activities, in addition to the assessment and perception criteria and processes used by the stakeholders when assessing factors contributing to human errors based on the Rasmussen model.

The **table 4** denotes general information on other stakeholders (sponsors, clients, project management SMEs, PMO coordinators and contractors) included in the semi-structured interviews.

After assessing the interviews and documentary evidences above, a list of critical errors found in the project management processes was established and shared with these stakeholders to weigh errors and assess perceptions about their influence on the project, assigning an order of importance to the errors and their level of frequency in the company's projects.

Finally, to develop the Rasmussen model for project decision-making and assess the influence exerted by each cognitive process on the errors studied in each project management process, the authors proposed Table V (as discussed below), which correlates each error studied to the decision-making stages. It details the most important cognitive processes and specifies the fulfilment level for each process task.

4 RESULTS

After compiling the process documentation used to manage the 14 projects in execution, the questionnaire answered by the stakeholders and semi-structured interviews were applied to other stakeholders (preferably in focus groups). The author could describe the impact of the deviations on the project schedule, costs, scope, and quality indicators. **Table 5** describes the deviations defined by the stakeholders, thus sizing the impact exerted on the studied projects. Furthermore, delays and cost overruns were assessed by a percentage scale that rates the degree to which projects were affected. Finally, the scope and quality were assessed using a qualitative assessment that defines the project as unacceptable or unusable (not recoverable).

As it can be seen, 11 of the 14 projects failed, one of which had a scope and quality flaw that qualifies it as unusable. Two other projects reported cost overruns exceeding 40% and delays of at least 20% from the original schedule, and two others reported 20% in cost overruns and a 10% delay. The remaining six (6) projects failed owing to other no-less important deviations.

After identifying the projects with the most complex affectations, according to the deviations hindering the achievement of the objectives proposed, the deviations were related to determining human errors regarding slips, oversights and lapses, memory and attention failures and interference errors, as depicted in **table 6**.

After the list of errors related to each deviation was completed, we assessed their impact on the projects (1—less impact and 11—greater impact) and perception regarding their probability of occurrence: (1) rarely, (2) occasional, (3) probable, (4) frequent and (5) continuous. Based on the number of responses for each error, we could establish the order described in **table 7.**

* Total Weight = Average Impact Weight Value + (Perceived probability value × % by total respondents with matching criteria / 100).

Based on this information, only the deviations from scope exceed 10 points, particularly regarding the existence of errors such as incomplete definition of stakeholders and unclear objectives. Other errors were incomplete requirements and lack of a business case, even when they did not obtain a conscious critical assessment in both groups of directors and other stakeholders.

5 Findings Discussion

After defining errors and their weight as critical factors for project success, the Rasmussen model was developed, focusing on the first four errors within the launch, planning and execution macro-processes and particularly, the processes below:

1. Business case (poor clarity, poor estimates): Business cases are usually discussed during the preliminary project phase and then during the planning and project management phases.
2. Project objectives (unclear), development of the project charter and gather requirements.
3. Stakeholder identification (incomplete).
4. Gather requirements (incomplete).

Both survey and interview results and the reviewed documentary information reveal that most project delays are caused by poor project planning, starting with the basic

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processes from the scope management area. It can also be attributed to poor time and resource estimates associated with deliverables, followed by ineffective management.

Among the most important factors resulting from human errors are incomplete definition of stakeholders, incomplete requirements, lack of a business case and unclear objectives. All these errors were related to the project kick-off stage, particularly related to integration and scoping of management areas. Moreover, the interviews also observed poor communication between the project sponsors and contractors who end up blaming each other for their errors.

As an example, the analysis performed for the error identified when complying with the stakeholder identification process is shown in.

As seen in table 8, at the Rasmussen model level for a single process (stakeholder definition), several types of deviations coexist, with each one being determined by the inadequate management of the knowledge- and rule-based decision-making processes.

For the knowledge-based decision-making process, there should be greater conscious execution or performance controls. The error could be caused by decision-making without enough information or based on erroneous assumptions, which unequivocally lead to heavily flawed plans that are susceptible to error.

For rule-based decision-making process, we expect that a large part of the rules applied can lead to errors, considering that they were established because of incomplete and insufficient stakeholder knowledge often based on the superficial assessments of each context and underestimating aspects related to culture, complexity and background, in the case of the stakeholder.

Among the tasks defining the stakeholder identification process, tasks #1 and #2 are critical, as the quality and effective fulfilment of these tasks will guarantee normal development of the rest of the process stages or tasks.

When fulfilling these tasks, the project manager must highlight for his/her superior relationship and communication skills such as:

- Develop language skills (verbal, written and non-verbal)
- Create and develop communication
- Communicate consistently
- Understand the communication needs from project stakeholders

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- Ensure that communications are clear, complete and relevant
- Incorporate feedback channels
- Evidence relationship skills with formal and informal networks (subject matter experts and influential leaders)
- Involve multiple people to solve problems and get around the paperwork in the projects.

It is important to be clear about the lessons provided by other projects and the ability to read and interpret various circumstances facing similar processes in previous projects, including conflicts with stakeholders and how they were resolved. The importance of devoting the necessary time and discipline to the completion of these processes must not be underestimated.

The **table 9** summarises the assessment of other three errors identified in projects with the cognitive processes for each Rasmussen model stage and based on the results from this research.

In these errors, automation is evident in the activation and observation processes, which fail to consider the assessment and awareness processes of the decisions made to complete project processes and tasks. These acts lead to error when people fail to notice environmental changes and overlook the cognitive processes of conscious attention, perception of environmental elements and events and thought meditation to understand the meaning and projection of their current state and consequences. Therefore, it is not strange that all tasks include unconscious procedures, practices or actions even in project management where, by definition, tasks are geared towards meeting specific objectives. Hence, the lack of planning and conscious review of our actions can lead to human error.

In the three errors reviewed in Table IX, a common aspect is the knowledge-based level, where the actors who led each project management process must explicitly represent this knowledge. They must demonstrate independent reasoning mastery regarding the application, a skill set that can allow them to successfully explain and socialise the conclusions and reasoning processes executed, as well as evidencing a proper performance level in a specific project management field or domain.

6 Conclusions

This research implements cognitive ergonomics in project management processes and tasks, thus unveiling a new field where human actions aimed at information processing and project-related decision-making can be associated with human error assessment from cognitive research.

Based on the analysis of human error causes for projects included in the research study, some of the significant errors noted in these projects were caused by different systems used to plan and develop them. Shortcomings associated with management practices, work culture and mindsets, lack of planning and poor knowledge management were all deemed system factors leading to at least four of the projects included in the research to fail.

The scope of Rasmussen model identified the root causes of human errors, further unearthing the variables that directly lead to human error after discriminating between automation-, rule- and knowledge-based actions.

Once the root causes that govern human errors in project management have been determined, effective error detection systems, supported by deviations in the expected project performance, objectives and scope of the project deliverables managed, can be designed. Human errors are often caused by flaws in the sociotechnical system, which requires the assessment of immediate and basic causes (roots) and demand comprehensive strategies that exceed information processing and individual decision-making framework.

Proper motivation regarding learning from errors, coupled with a strong commitment to the corresponding training management and processes, can foster active participation from most company stakeholders and provide support for meeting system demands. Grounded on this foundation, an organisational culture that permeates project management and the best practices implemented by its managers can be developed.

Within the fundamental limitations of this research, in addition to the difficulties faced when attempting to extend our assessment to other projects, we must also highlight the issues faced in the companies when performing a multidimensional analysis of the effects on the cognitive processes exerted by errors identified in both companies. In future research, we suggest more in-depth studies based on knowledge and cognitive processes involved. Thus, the project teams can propose more assertive management strategies that are better aligned with the knowledge management strategies that were recently implemented in several other projects.

References

[1] International Ergonomics Association (IEA), Ergonomics guidelines for occupational health practice in industrially developing countries. Ergonomics at the University of Darmstadt (Germany), 2010. Accessed: 15 Jan 2019 [Online] http://www.icohweb.org/site/multimedia/pubblicazioni/ICOH%20and%20IEA%20Ergonomics%20Guidelines%20April%202010.pdf.

[2] J. Reason, "The Human Contribution: Unsafe Acts, Accidents and Heroic Recoveries," Madrid: Editorial Modus Laborandi, S. L.; pp. 1–289, 2011, doi: 10.1016/j.ssci.2009.09.006.

[3] R. Hernández, W. Quezada and J. Hernández, "Human reliability, contribution to the quality of projects in Cuban companies of hydraulic engineering services," (in Spanish). V Ibero-American Project Engineering Conference (V CIIP) (http://congreso.riipro.org/) - Loja. Ecuador. 1–16. 2014.

[4] A. Mishra, "Learning from mistakes," *Journal of Motilal Rastogi School of Management* vol. 5, no. 2, pp. 22–31, March 2012, ISSN: 0974-4037.

[5] Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide, 6e)," Newtown Square, Pennsylvania: Project Management Institute, Inc., 2017, doi: http://dx.doi.org/10.31095/podium.2018.34.6.

[6] F. Mir and A. Pinnington, "Exploring the value of project management: linking project management performance and project success," *International Journal of Project Management*, vol. 32, no. 2, pp. 202–217, 2014, doi org/10.1016/j.ijproman.2013.05.012.

[7] R. Müller and R. Turner, "The influence of project managers on project success criteria and project success by type of project," *European Management Journal*, vol. 25, no. 4, pp. 298–309, August 2007, doi: 10.1016/j.emj.2007.06.003.

[8] H. Kerzner, "Project Management - A Systems Approach to Planning, Scheduling, and Controlling," (10a. ed.). New York: Wiley. 2009.

[9] PricewaterhouseCoopers, Insights and Trends: Current Portfolio, Programme, and Project Management Practices, The third global survey on the current state of Project Management. United Kingdom: PricewaterhouseCoopers,

2012. Accessed: 20 Feb 2019. [Online] Available: https://mosaicprojects.com.au/PDF/pwc-global-project-management-report-2012.pdf.

[10] J. Rasmussen, "Skills, Rules, and Knowledge: Signals, signs and symbols, and other distinctions in human performance models," *IEEE Transactions on Systems, Man and Cybernetics*, vol. 13, no. 3, pp. 257–266, May-June 1983, doi: https://doi.org/10.1109/TSMC.1983.6313160.

[11] G. Stock, K. McFadden and C. Gowen, "Organizational culture, critical success factors, and the reduction of hospital errors," *International Journal of Production Economics*, vol. 106, no. 2, pp. 368–392, April 2007, doi: 10.1016/j.ijpe.2006.07.005.

[12] D. Dozois, R. Martin and P. Bieling, "Early maladaptive schemas and adaptive/maladaptive styles of humor," *Cognitive Therapy & Research*, vol. 33, no.6, pp. 585–596, December 2008, doi: 10.1007/s10608-008-9223-9.

[13] J. Ely, L. Kaldjian and D. D'Alessandro, "Diagnostic Errors in Primary Care: Lessons Learned," *The Journal of the American Board of Family Medicine*, vol. 25, no. 1, pp. 87–97, January 2012, doi: 10.3122/jabfm.2012.01.110174.

[14] J. Santiago, F. Tornay, E. Gómez and M. Elosúa, "Basic Psychological Processes," (Spanish). MªR. Madrid: McGraw Hill, 2006.

[15] M. Rivas, "Cognitive Processes and Significant Learning," (Spanish). Madrid: Comunidad de Madrid, 2008.

[16] W. Huitt, "Bloom et al.'s taxonomy of the cognitive domain. Educational Psychology Interactive," Valdosta, GA: Valdosta State University, 2011. Accessed: 13 March 2019. [Online] Available: http://www.edpsycinteractive.org/topics/cognition/bloom.html.

[17] A. Melamed, "Emotions and their Relation to Cognition: Reflections about Anthony Kenny's Objections against Feeling Theories. Disputatio," *Philosophical Research Bulletin*, vol. 7, no.8, December 2018, doi: 10.5281/zenodo.2550913.

[18] Y. Wang, "On the Cognitive Processes of Human Perception with Emotions, Motivations, and Attitudes," *International Journal of Cognitive Informatics and Natural Intelligence,*

vol. 1, no. 4, pp. 1–13, January 2007, doi: 10.4018/jcini.2007100101.

[19] A. Raftopoulos, "Cognition and Perception How Do Psychology and Neural Science Inform Philosophy?" Cambridge, MA: MIT Press. 2009, doi: 10.1068/p3903rvw.

[20] M. Lupón, A. Torrents and L. Quevedo, "Psychology notes in visual attention," (Spanish). [en línea]. Terrassa: UPC, 2012. Accessed on: 11 Jan 2019. [Online] Available: http://ocw.upc.edu/curs_publicat/370508/2012/1/apunts,

[21] J. Mosterín, "The Human Nature," (in Spanish). Madrid, Espasa Calpe: España. 2006.

[22] A. Guarneros, "*The unity of thought (in Spanish). En-Claves del pensamiento*," México, MX: The Monterrey Institute of Technology and Higher Education at Mexico City. CDMX, no. 16, pp. 79–97, 2014.

[23] M. Frese and N. Keith, "Action Errors, Error Management, and Learning in Organizations," *Annual review of psychology*, vol. 66, pp. 661–87, January 2015, doi: org/10.1146/annurev-psych-010814-015205.

[24] D. Hofmann and M. Frese, "Errors in Organizations," New York: Routledge, Taylor & Francis. 2011.

[25] L. Cronbach, "Coefficient alpha and the internal structure of tests," *Psychometrika*, vol. 16, pp. 297–334, September 1951, doi: https://doi.org/10.1007/BF02310555.

LIST OF FIGURES

Figure- 1**. Factors contributing to poor project performance adapted from PricewaterhouseCoopers (2012).**

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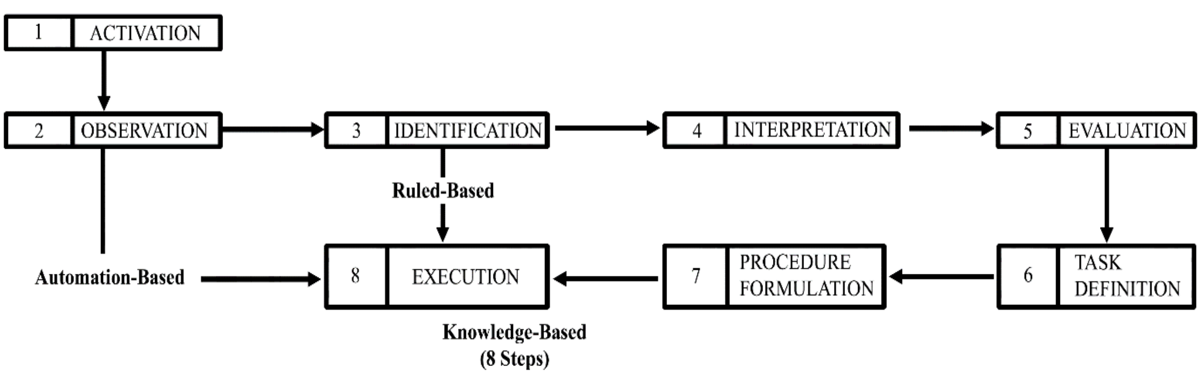
Figure-2. Decision-making and information treatment cognitive processes (Rasmussen, 1983)



LIST OF TABLES:

Table 1. General information of the projects in execution

Project amounts	Projects in execution	
(Millions of COP)	Company 1	Company 2

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100–400	2	
400–1500	2	7
1,500–6,000		3
Total	4	10

Table 2. Number of stakeholders and interviewees by company

Stakeholders	Company 1		Experience	Company 2		Experience
	Total	Interviewee	Years	Total	Interviewee	
Project managers	4	2	2–5 (50%) 5–10 (50%)	10	10	3–5 (60%) 5–10 (30%) <10 (10%)
Other stakeholders (sponsors, clients, project management SMEs, PMO coordinators and contractors)	30	16	2–5 (50%) 5–10 (50%) <10 (10%)	74	40	3–5 (40%) 5–10 (30%) <10 (30%)
Total	34	18		84	50	

Table 3. Reliability of the scale used to measure organisational culture

Dimensions	**Item**	**Factor load**	**KMO**		**Cronbach's alpha**
Deviations from project objectives	1	.836	KMO	.838	.807
Human error	2	.797	χ^2	160.9	
Project Management	3	.853	Sig.	.000	

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processes and areas	4	.781			
Cognitive levels: • Rule-based • Automation-based • Knowledge-based	5	.832	KMO	.841	.851
	6	.793	χ^2	180.4	
	7	.814	Sig.	.000	
	8	.786			
	9	.840	KMO	.844	.882
	10	.901	χ^2	315.1	
	11	.861	Sig.	.000	
	12	.844			

Table 4. General interviewee information based on experience and relation to projects by budget

Work field	Interviewee (%)	Years of Experience	Interviewee (%)	Project budget (Millions of COP)	Interviewee (%)
Sponsor	6	<1	4	<400	10
Clients	50	1–5	25	400–1 500	60
Project and PMO Professionals	7	5–10	37	1,500–6,000	30
Contractors	37	>10	34	>6,000	0

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Table 5. Summary of deviations from project objectives

Projects	Effect on scope	Delays			Cost overruns			Effect on quality
		H%–10%	11%–20%	+20%	H%−20%	20%–40%	+40%	
Project 1	Unacceptable	x			x			Unacceptable
Project 2			x					
Project 3	Unacceptable	x				x		Unacceptable
Project 4								
Project 5		x						
Project 6				x				
Project 7	Unacceptable	x				x		Unacceptable
Project 8		x			x			
Project 9	Useless	x					x	Useless
Project 10								
Project 11		x			x			
Project 12								
Project 13	Unacceptable	x			x			Unacceptable

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Project 14	x	x

Table 6. Relationship between human error and deviations per project

Projects	Deviations	Magnitude	Error description		
			Slips, oversights and lapses	Memory/attention failures	Interference errors
Project 1	Effect on scope	Unacceptable	Stakeholder identification errors	Project resource estimation errors	Unclear objectives. Poor communication between project sponsors, clients and stakeholders
	Delays	10%			
	Cost overruns	20%			
	Effect on quality	Unacceptable			
Project 3	Effect on scope	Unacceptable	Budgeting errors Poor material and equipment estimate	Stakeholder requirements are incomplete	
	Delays	10%			
	Cost overruns	20%–40%			
	Effect on quality	Unacceptable			
Project 7	Effect on scope	Unacceptable	No corrective or preventive actions were taken to anticipate risks		Poor communication between project sponsors, clients and other stakeholders
	Delays	10%			
	Cost overruns	20%–40%			
	Effect on quality	Unacceptable			
Project 9	Effect on scope	Useless	Risk response plans were not	Project resource estimation errors	High resistance to change

	Delays	10%	implemented Poor material and equipment estimate	Progress meetings were not held
	Cost overruns	+40%		
	Effect on quality	Useless		
	Effect on scope	Unacceptable		
Project 13	Delays	10%	Poor material and equipment estimate	High resistance to change Progress meetings were not held
	Cost overruns	20%		
	Effect on quality	Unacceptable		

Table 7. Assessment of perceived probability and impact of project errors

Deviations	Errors	Weight impact		Perception probability		Weight Total*	
		Other stakeholders	Managers	Other stakeholders	Managers	Other stakeholders	Managers
Deviation from scope	Incomplete stakeholder identification	9	10	5 (54%)	5 (67%)	11.7	13.35
	Incomplete requirements	11	5	5 (31%)	5 (75%)	12.55	8.75
	No business case	7	11	3 (11%)	4 (33%)	7.33	12.32
	Unclear objectives	10	8	3 (27%)	4 (83%)	10.81	11.32
Deviation delays	Unrealistic time estimates	6	6	4 (43%)	3 (92%)	7.72	8.76
Deviation	Unrealistic cost	5	2	4 (32%)	3 (67%)	6.28	4.01

cost overruns	estimates						
Deviation from quality	Unrealistic expectations	8	7	2 (38%)	4 (67%)	8.76	9.68
	Lack of resources	1	1	2 (45%)	2 (50%)	1.9	2
	Poor Communication	3	4	4 (47%)	4 (100%)	4.88	8
Deviation management	Poor change management processes	4	9	3 (9%)	3 (33%)	4.27	9.99
	Lack of knowledge and skills	2	3	4 (40%)	4 (28%)	3.6	4.12

Table 8. Relationship between incomplete stakeholder definition error and cognitive processes for each Rasmussen model stage

Macroprocess/ Management area	Tasks	Deviation	Error identified	Rasmussen model stage	Rasmussen model level	Cognitive processes
Project kick-off, planning and execution macro-processes	1. Understand policies, power structures,	Deviation from scope and limitations: • Unacceptable • Useless • High Probability High Impact	Limited understanding of scope and limited importance of the stakeholde	Observation Identification	Rule-based level Knowledge-based level	PERCEPTION Sensory perception: • Visual and auditory • Location and time ATTENTION • Sustained

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Stakeholder management area Stakeholder identification	culture and the individual contributions from each member of the organisation's team		r definition process			• Concentrated • Open and Conscious
	2. Collect data	Deviation from scope and limitations: • Unacceptable • Useless • High Probability, High Impact	Limited and incomplete stakeholder registration Poor business analysis	Identification Target selection	Knowledge-based level Knowledge-based level	MEMORY • Short term LEARNING • Operative and Cognitive
	3. Assess dat	Deviation from scope and limitations: • Unacceptable • Useless • High Probability High Impact	Incomplete stakeholder assessment Poor	Select procedure	Rule-based level	THOUGHT • Conceptualisation • Decision-making • Argumentation.

			record of changes and incidents	Identification	Knowledge-based level	EMOTION • Cognitive • Behavioural
	4. Represent data	Deviation from scope and limitations: • Unacceptable • Useless • High probability High impact		Target selection	Knowledge-based level	METACOGNITION • General knowledge • Foresight capacities
	5. Classify stakeholders		Incomplete stakeholder definition and assessment	Target selection	Knowledge-based level	LANGUAGE • Verbal • Non-verbal

Table 9. Relationship between errors (business cases, project requirements and objectives) and cognitive processes for each Rasmussen model stage

acroprocess/ Management area	Processes	Tasks	Error identified	Rasmussen model stage	Rasmussen model level	Cognitive processes
Preliminary project plan	Business case	Needs assessment	Poor clarity when defining the problem or objective	Objective interpretation, assessment and	Knowledge-based level	LEARNING Operative and

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		Projects not aligned with organisational strategy	selection		cognitive MEMORY Medium-term THOUGHT Conceptualisation Decision-making Argumentation SENSORY PERCEPTION Location and time
	Situation assessment	Cultural factors are ignored	Observation	Automation-based	
	Feasibility	Poor cost	Select	Knowl	LEA

		study	and benefits estimates	procedure	edge-based level	RNING Operative and cognitive
Macroprocess: Planning Management area: Scope management	Gather requirements	Determine requirements	Poor Stakeholder selection and/or participation False assumptions	Identification	Rule-Based level	SENSORY PERCEPTION Location and time
				Select procedure	Knowledge-based level	THOUGHT Conceptualisation Argumentation
		Document requirements	Difficulty measuring and validating	Identification	Rule-based level	LEARNING Operative

						and cognitive THOUGHT
				Select procedure	Knowledge-based level	Conceptualisation Argumentation ATTENTION
		Prepare Requirements Matrix	Poor alignment between requirements and objectives	Activation and observation	Automation-based	Sustained Concentrated Open and conscious
Macroprocess: Kick-off and planning	Project Objectives	Prepare business case Project Charter: Define	Unclear project objectives Difficulty measuring and	Interpretation Assessment and selection	Knowledge-based level	LEARNING Operative and

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Management area: Integration and scope management	measurable objectives and associated success criteria	validating objectives	Identification	cognitive MEMORY Medium-term THOUGHT Conceptualisation Argumentation
	Align stakeholder requirements to project objectives	Unusable or rejected deliverables, deliver more than requested		