



NAC Executive Insights

Dirty Dozen

Key Points

- Project management deals with human beings networked and interact in ever-changing ways.
- Human factors are important on all projects, but on large complex projects the network of interactions grows in nonlinear ways.
- Human factors affect safety, quality, cost, performance, and schedule.
- The dirty dozen human factors are outlined and discussed.
- They provide an initial checklist of human factors for project and construction managers.

Introduction

Human factors affect safety, quality, cost, performance, and schedule. They are important on all projects, but on large complex projects the network of interactions grows in nonlinear ways. This nonlinearity is often underappreciated, as are:

- human factors related to the management systems deployed.
- work process in use and the tasks performed with them.
- equipment in use and the facilities where they are operated.
- a broad set of environmental and contextual factors.

These human factors are affected by each of the aforementioned, but also act on each, further shaping them.

This Executive Insight will show the suite of human factors to be considered in large complex projects is much broader, takes on increased importance, and requires even more attention because of project size and complexity.

Twelve Human Factors or the “Dirty Dozen”

Project management is about many things. At its core it is about mobilizing resources to deliver output or outcomes. The resources mobilized generally consist of labor, materials, and equipment. It is not atypical for direct construction labor cost to account for 40 percent of total constructed cost. Labor, however, is not simply a cost item. Human beings are networked and interact in ever-changing ways.

Gordon Dupont, the first president of the Pacific Aircraft Maintenance Engineers Association, identified twelve factors¹ that contribute to errors in judgement and ultimately to errors in performance. These are shown in Table 1. They represent a good starting point when evaluating and avoiding human error.

Table 1 Dirty Dozen	
1.	Lack of Communication
2.	Complacency
3.	Lack of Knowledge
4.	Distraction
5.	Lack of Teamwork
6.	Fatigue
7.	Lack of Resources
8.	Pressure
9.	Lack of Assertiveness
10.	Stress
11.	Lack of Awareness
12.	Norms

Communication

Communication is the exchange of information, not just the exchange of data. Communication requires a conveyance of context and must be free of bias. One of the greatest challenges to communication is the perception that communication exists. Transfer of information must avoid framing questions that act to limit its objective use, often by eliminating or discouraging critical information and thinking. “This result looks ok, don’t you agree?” is an example of a framing question.

Communication requires:

- breaking down barriers.
- promoting transparency whether the news is good, bad, or ugly.
- having clear, consistent messages that are communicated through multiple channels.
- being continuous.
- and being equally open, up, down, and sideways.

¹ *The Dirty Dozen Errors in Maintenance* by George Dupont

Communication at transition and handoff points is especially important and requires a well-defined and structured approach.

Complacency

A root cause of complacency is often overconfidence². A “been there, done that” attitude is especially dangerous in complex situations. Our instinctive use of pattern recognition often overly simplifies what we are seeing. We are looking at the situation through a straw and not seeing the complete picture. Even if we have considered the broader picture, we must remember that a snapshot in time does not necessarily tell you the trajectory of the “project movie.”³

The use of artificial intelligence⁴ in assessing project performance and trajectory provides us with an objective assessment that can then allow a basis for confidence in project conditions.

Lack of Knowledge

Lack of knowledge can take many forms. It can range from an explicit lack of required technical knowledge; confrontation with a new problem type; lack of clarity on project processes or protocols; team-based role uncertainties (what is my job; what is yours); and an absolute absence of required data.

When faced with any of these knowledge challenges, there may be a tendency to not ask for help or avoid asking questions that might expose one’s ignorance.

Remember: all of us together are smarter than any one of us. Engage diverse teams to gain required knowledge and, most importantly, to gain perspectives.

Distraction

Distraction is a particularly important human factor in any task-based work, whether it be cerebral or manual. As an example, when I write, my mind moves faster than my finger (yes, just one!) over the keyboard. Often, I will find that I never typed the middle part of a sentence since my mind had already jumped to the end of a thought.

Certain tasks require “head down” with an almost laser-like focus on the task at hand. Other tasks require a satellite view. Shifting from one to the other, however, may cause important details to be missed.

² NAC Executive Insight, A Failure of Logic

³ B. Prieto, “Project Categorization and Assessment Utilizing Multivariate Statistical Techniques to Facilitate Project Pattern Recognition, Categorization, Assessment and Pattern Migration Over Time”
https://www.researchgate.net/publication/272504828_Project_Categorization_and_Assessment_Utilizing_Multivariate_Statistical_Techniques_to_Facilitate_Project_Pattern_Recognition_Categorization_Assessment_and_Pattern_Migration_Over_Time

⁴ NAC Executive Insight, Impacts of Artificial Intelligence on Management of Large Complex Projects

Distractions arise not just from how we work, but also from a full range of work processes and environmental factors. Periodically we must stop and ensure that we and our teams are focused on the task at hand. If necessary, the task may need to be reframed.

Lack of Teamwork

Large complex projects are delivered by teams, not individuals. These teams are multidisciplinary in nature and dynamic in composition. Many team-based relationships can be transitory in nature. This contributes to the challenges that human factors bring. Even in recurring tasks, daily context may change necessitating an ongoing assessment of fit-for-purpose. This is perhaps most noticeable in workforce planning of construction tasks.

Lack of teamwork can also be affected by a full range of interpersonal issues. Engagement with each and every member of the team on a frequent and, if possible, informal basis can help create commitment and a cooperative *esprit de corps*.

Fatigue

Fatigue affects project performance during routine as well as exceptional periods. During routine periods, tiredness and loss of energy or focus can result from environmental factors such as extreme temperature or other environmental stresses (sandstorms, monsoons, and infestations). Shift work can interrupt circadian rhythms. Split shifts have shown to not allow an individual to fully recover from overall fatigue.

Exceptional project periods include excessive overtime for extended periods and responses to crises. Studies⁵ have shown the significant impact on productivity from extensive project overtime. Impacts relate to both the level of overtime and its duration.

One often overlooked environmental factor is morale. Constant operation in a poor morale environment takes not only a psychological toll, but a physical one. Team dynamics must be monitored and exercised. Empathy is an important leadership and team member skill.

Lack of Resources

Large complex projects are subject to numerous requirements for contingent execution. Capacities and capabilities are often more important than pure headcount. Resource shortages are not just from lack of qualified individuals, but also shortages of the resources they may require. As an example, during the COVID-19 pandemic, shortages of PPE were a significant negative human factor.

⁵ Mechanical Contractors Association, Change Orders Productivity Overtime, 2016 Edition <http://tiac.ca/wp-content/uploads/2017/09/I-Change-Orders-Productivity-Overtime-A-Primer-for-the-Construction-Industry.pdf>

In complexity there is a need for granularity. This means the right resources in the right place at the right time. Workforce planning provides an excellent context for identifying required resources to efficiently undertake tasks at hand.

Pressure

Internal and external pressures exist. The right amount of stress at the right time in the right place can be motivating. In large complex projects, however, multiple vectors are applying pressure on individuals, teams, and the project as a whole. These vectors may originate from owners, regulators, partners, stakeholders, or suppliers. Internal pressures may derive from others in the project team as well as be a result of self-pressure.

Individual pressure often arises from a false perception that asking for help is viewed as a sign of weakness. Internal pressures can be relieved through a range of time management techniques including: prioritization, delegation, and asking for help. Escalation of issues requires effective communication regimes to exist.

Lack of Assertiveness

A lack of assertiveness is often associated with a lack of confidence and weak 360° communication. It is often displayed as a reluctance to speak up or take action. Diverse teams can outperform teams of experts, but only if the strength in diversity (of thinking) is allowed to manifest through communications, decisions, and actions.

Assertiveness is typically coupled with strong self-confidence. In one instance a CEO was asked if there was any retribution for expressing a view. The CEO's answer was "No. You have to have an opinion, and you need to own it."

Stress

"Everyone is a package." That is advice given by a very smart woman. People are not just the sum of their work experiences. They are the sum of those and a full range of personal experiences and situations. Stress may derive from outside the work environment as well as from within it. If one regards the cumulative effect from the range of stresses that affect people as a bell-shaped curve, then as project teams grow larger in large complex projects, more and more individuals will fall under the tails of the curves. Some will excel under stress while others become unmitigated disasters.

Maintaining mental health is important in the proper functioning of any team. A whole of body and mind approach is essential. Initiatives to promote physical health and mindfulness will pay dividends. Particular attention is required in mixed (in person and remote) work environments.

Lack of Awareness

Related to complacency, a lack of awareness can arise from: a lack of alertness, a lack of relevant experience, or a lack of vigilance. We have discussed some factors which can contribute to a lack of alertness such as distraction and fatigue. A lack of situational awareness is often associated with a lack of vigilance. It arises from an unclear mental picture of what is going on around an individual and how it may evolve.

Strategies to mitigate the potential for lack of awareness include frequent safety huddles and avoiding single task fixation. Frequent communication to check and confirm the current state of play are also helpful.

Norms

Norms are unwritten rules that are followed by defined groups. They also may be presented as behaviors tolerated by similar groups. One of the problems created by norms in large complex projects is they may not be consistent or supportive across sub-elements of the project. On one megaproject, a major contractor required tie-off if working at elevations above six feet. The contractor on the adjoining section did not have such a requirement and labor was coming out of the same union hall. The respective norms were in conflict and the logical reconciliation parties, owner and union, did not seek to reconcile this clash of norms.

Norms can sometimes act to undermine the effectiveness of established project processes. They also can cloud an assessment regarding the true condition of large complex projects. Successful team building efforts can align project processes with team values and norms that support the overall mission.

Summary

Human factors are important on all projects, but on large complex projects the network of interactions grows in nonlinear ways. The dirty dozen presented here provides an initial checklist for project and construction managers with regards to what they are likely to encounter on their projects.

References

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