



Research Studies: Correlation Between Re-work and Craft Employee Injury Rates

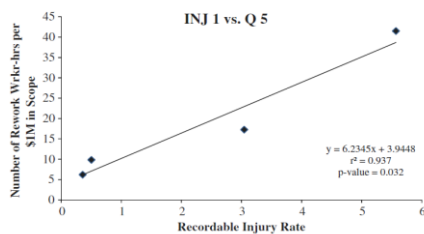
The purpose of this White Paper is to summarize a few publications that have been published showing the Correlation between craft injuries on construction sites and the costs of Re-work. While the author has reviewed many studies the below few are the most relevant in showing a direct relationship between higher Re-Work hours/costs and injuries to craft employees.

1. Publication title: *Relationship between Construction Safety and Quality Performance*, Abstract.

[https://ascelibrary.org/doi/full/10.1061/\(ASCE\)CO.1943-7862.0000732](https://ascelibrary.org/doi/full/10.1061/(ASCE)CO.1943-7862.0000732) (J. Wanberg, C. Harper, M. Hollowell, S. Rajendran. 2013).

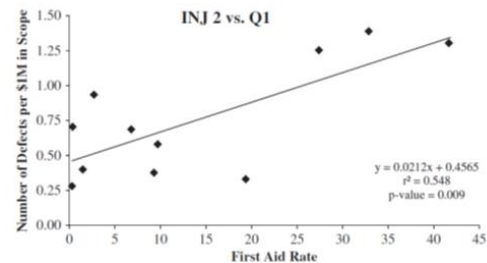
The researchers collected data from 32 projects ranging in size from \$50,000 to \$300,000 finding direct correlation between “Re-work” (e.g., cost of rework per \$1M project scope and rate of rework per 200,000 worker-hours) and craft injuries (first aid and Occupational Safety and Health Administration (OSHA) recordable injury rates). Figure one (1) from the research is representative, which shows direct corresponding relationship to increasing injury rates of first aids to hours contributed to Re-work.

Other craft injury measurables (i.e. Recordable rates) have similar direct comparable relationships (increased craft injuries equalities to increasingly more hours charged to craft Re-work”.



Recordable injury rate per 200,000 worker-hours (INJ1) versus the number of worker-hours related to rework per \$1 million of scope of project completed (Q5)

Figure taken from *Relationship between Construction Safety and Quality Performance*. P.6. (J. Wanberg, C. Harper, M. Hollowell, S. Rajendran. 2013).



First aid rate per 200,000 worker-hours (INJ2) versus the number of defects per \$1 million project scope completed (Q1)

Figure taken from *Relationship between Construction Safety and Quality Performance*. P.7. (J. Wanberg, C. Harper, M. Hollowell, S. Rajendran. 2013).

A positive linear relationship was found, with an r^2 value of 0.937, between the recordable injury rate per 200,000 worker hours (INJ1) and the number of worker-hours related to rework per \$1million scope of project completed (Q5). This means a very strong positive relationship exists. As the number of rework hours increases, the recordable injury rate linearly increases!

In the correlation shown in Fig. 1, a positive relationship was found between the first-aid rate per 200,000 worker-hours (INJ2) and the number of defects per \$1 million project scope completed (Q1). The r^2 value of 0.548 represents a strong relationship between these two metrics, meaning as the number of defects on a project in-creases, the number of first-aid injuries also increases, as depicted in the figure above. The associated p-value 0.009 led to a rejection of the null hypothesis.

2. Publication title: *Rework Causation That Undermines Safety Performance During 2 Production in Construction*. Journal of Construction Engineering and Management, 146(9), Article number: 04020106. This file was downloaded from: <https://eprints.qut.edu.au/202154/>. (Yap, Jeffrey Boon Hui, Rou Chong, Jia, Skitmore, Martin, & Lee, Wah Peng. 2020).

This article shows how rework causation undermines safety performance. “...Given the positive association between rework and safety incidents, the identified rework-safety causes also have significant practical and training implications for the construction industry. Construction managers and workers need to be cognizant and aware of the precursors of rework that also influence safety incidents, as ignorance and oversight of the critical issues will likely trigger accidents...”



3. Publication title: *State of Science: Why Does Rework Occur in Construction? What Are Its Consequences? And What Can be Done to Mitigate Its Occurrence?* Engineering, Volume 18, 2022, P. 251. ISSN 2095-8099, (<https://www.sciencedirect.com/science/article/pii/S209580992200426X>). (P. Love, J. Matthews, M. Sing, S. Porter, W. Fang. 2022).

Section 4.2 discusses the Impact on Safety. "... if construction organizations are to improve safety performance in their projects significantly, they must effectively deal with the errors and violations that result in rework being required ..."

Conclusion

The increased safety risks and increased safety incidents associated with Re-work in Construction most likely does not surprise those in the Safety and Health Profession. Factors that contribute to the need for Re-work often are the same factors that contribute to safety incidents. These include fatigue, stress, workload, inadequate training, and/or limited experience as well as a toxic work environment rife with a lack of psychological safety. A strong safety culture can reduce errors that contribute to Re-work, or at the very least create a culture where team members are comfortable in speaking up to report work errors, discrepancies, or contradictions in plans and/or product use/install and damage, etc. An effective injury prevention and quality control program (specifically pre-job planning, on-going craft training and management visible support) will reduce craft injury and Rework.