

experimental area were some of the primary causes of noise.

4.4 Value added to the project

The technologies in this case study show that complete automation can only be achieved through the TLS mounted ARS approach. This approach has proved efficient in construction sites in various instances [5]. However, this method commonly requires trained workers to collect and process raw information. It has proved to be fast and provides relatively complete point clouds with the highest density value. The method comparatively results in the highest standard data, but for a higher cost. This method can be proposed for large projects with higher contract amounts. In most cases, large construction sites produce a relatively large amount of waste and are easy victims of mismanagement. Manual operations could result in delayed data with little to no room to produce decisions before resources are wasted. On the other hand, small-scale and low-budget construction projects need to perform a cost-benefit analysis before choosing automated data acquisition methods. One of the important aspects of the examined technologies in this case study is the ability to create a simplified way of visualizing the construction site in 3D. This helps contractors, owners, and consultants devise construction decisions, safety measures and many more, which are usually time-taking activities.

The applicability (i.e., benefits) of the four comparison criterion for the methods evaluated in this case study is summarized in Figure 1. Applicability in the y-axis is a comprehensive measure composed of the four comparison criterion used in this study. Given the availability of digital cameras (economy and feasibility), photogrammetry is the most applicable method for small constructions. However, the quality of the data and the value that the processed data adds to the project varies between static and free-roaming photogrammetry. As the complexity of the project increases, the size of image data and the requirement of processing capacity (economy) increases. Based on the quality of data, the ease of obtaining the results (feasibility) and the value it adds to the project, TLS-based methods appear to be relatively applicable. Given the complexity of the construction, blind spots could be avoided, and data registration could be error-free if it is conducted with the help of an ARS.

5 Conclusions and future work

TLS and photogrammetry are used indistinctly of the applicability or suitability of the situation in which they are implemented but based on the availability of the required hardware/technology to the user. However, small-scale and low-budget contractors, especially in developing countries, often have to be specific regarding hardware requirements due to cost, availability or lack of

qualified personnel. This study looks at the development of point clouds acquired with TLS and photogrammetry and serves as a base to objectively compare the feasibility and usability of each technology.

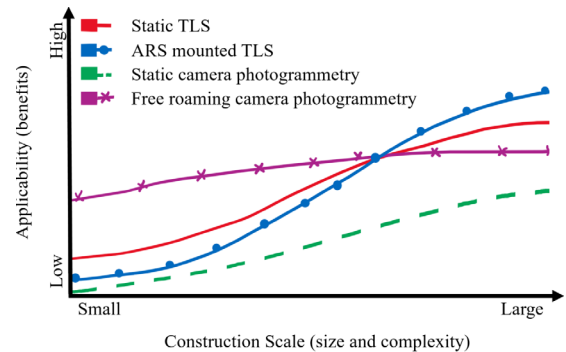


Figure 1: Comparative benefit of technologies investigated vs. the scale of construction project

The results are based on a small case study, which is not the best scenario to accurately represent the benefits of some of the technologies used. The study concludes that automated data acquisition provides reliable control with relatively low budgets for large and complicated construction projects. However, image-based methods could be more applicable for smaller construction projects, given their mild initial cost and skill requirement. Nevertheless, the value added to the process must be evaluated relative to the conventional methods.

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