The Use of Weather Website Data for Construction Project Decision-Making in The Short Term

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Abstract. In most work sites, it is a priority to keep the work going well and to avoid unforeseen incidents. Fluctuations in weather conditions are one of the factors affecting the continuity of work in construction projects. Indeed, for example, the temperature is important in concrete and asphalt works, and wind speed is important in lifting and high construction works. Therefore, taking the appropriate decision, starting and completing the work, is very important to maintain the quality of the project. This research aims to demonstrate the reliability of short-term decision-making through data taken from the weather site five days before the time to work. The data was collected for a month, five days before the intended day and on the same day, day and night, for different weather factors by weather location such as temperature, humidity, possibility of rain, Uv index, wind speed. By analyzing the data, it was found that there was little difference in those predictors of all the factors recorded. To conclude at the end of the study that it is possible to rely on the decision-making on the weather location in small and medium projects, but in large and sensitive projects, they need to rely on more accurate data than relying on weather location data.

Keywords: Weather, Factors, Construction projects, Temperature, Humidity, Possibility of rain, Uv index, Wind speed.

1. Introduction and Literature Review

Many building projects fail to meet their original completion dates. This is a widespread occurrence in many nations, and it impacts practically all sorts of construction activity(1)(2)(3)(4). Almost all stakeholders are affected by the delay (i.e., the failure to meet the initial completion date agreed upon between the Contractor and the Project Owner)(5). Late delivery of a project entails postponing the commencement of an asset's operation from the standpoint of a public or private project owner. This could result in a business opportunity being missed, a competitive advantage being lost, a return on investment being delayed, and earnings being reduced(6)(7).

Late completion can result in contractual penalties for contractors, as well as preventing resource reallocation for extended periods of time, reducing the productive potential of resources, and increasing the contractor's indirect and overhead expenses in general(8). Late initiatives make resource planning undesirable from the standpoint of subcontractors since resource demand estimations are imprecise; as a result, resource overlaps across different projects are more common(9). End users are virtually usually
dissatisfied and disappointed by late project delivery, especially if they reside nearby and/or are impacted by construction(10). In some cases, being late might be advantageous. Because a longer time period allows for more efficient resource allocation, event expenses, for example, can be reduced to some extent. Contractors, on the other hand, benefit nearly entirely from these "planned" delays, while other stakeholders just bear the repercussions(11).

One of the most common and harmful causes of project delays is the weather(12)(13)(14)(15). Weather can affect construction projects in a variety of ways, including lowering productivity and even stopping work(16); destroying unprotected and exposed building elements(17); interfering with correspondence and/or blocking access to specific places(18), to mention a few. When defining the effect of weather, it is common to distinguish between predictable and unpredictable weather(19), as well as severe and non-extreme weather events (which are usually combined)(20). Extremely bad weather that could disrupt the execution is referred to be anticipated weather or infrastructure misuse unless precautionary measures are implemented. The most common application of weather forecasting is during the construction of unique projects such as long, exposed bridges or high-rise structures(20)(21). Because these projects sometimes have substantial resources, technologies for assessing how and when on-site weather can cause planned activities to shift are more likely. Weather forecasting, both sub-seasonal and seasonal, has showed early promise, although forecasts of respectable quality only cover a 10-day timeframe at most(22).

Despite advances in forecasting, a chaotic system like the weather will always have intrinsic uncertainty, making accurate predictions unattainable all of the time. When it comes to climate-related extremes, this is especially true(23).

Furthermore, while some construction activities require forecast details to make sound short-term decisions, others do not (for example, whether to pour concrete today or tomorrow, or whether high winds would make working in exposed areas or at height impossible), the majority of resource-related organizational decisions, and, most importantly, all project planning, weather forecasting People (workers) can move about a lot, but their equipment, machines, cars, and special supplies can't always move with them(11).

This is why, in contrast to basic weather forecasts, this study evaluates the relevance of climatology data derived from past weather data. This isn't to say that the value of timely and sometimes critical short-term weather forecasting isn't recognized. The main objective of this work is to demonstrate the reliability of weather site data for ease of use in making short-term decisions in construction projects.

2. Experimental Work

The weather data was collected on a daily basis for a month. Five days ago, the results were recorded, and then they were recorded again on the same day. This methodology was used to demonstrate the difference in findings over a five-day period. The goal of this procedure was to show that the results of weather conditions collected from a weather website might be used in decision-making. This information was gathered throughout the month of January.

2.1. Factors That Have Been Studied

Five atmospheric elements were recorded via the weather website (temperature, humidity, possibility of rain, Uv index, wind speed) to be studied afterwards to determine the accuracy of the forecast until the possibility of making a decision in construction projects based on these results or not.
2.1.1. Temperature
Temperature is a physical number that describes how hot or cold something is. It is a manifestation of thermal energy, which is found in all matter and is the source of heat, a movement of energy that occurs when one body comes into contact with another that is colder or hotter(24). Temperature is significant in physics, chemistry, Earth science, astronomy, medicine, biology, ecology, material science, metallurgy, mechanical engineering, and geography, as well as most elements of everyday life.

2.1.2. Humidity
Humidity refers to the amount of water vapor in the air. The gaseous condition of water, known as water vapor, is often invisible to the naked eye. The presence of precipitation, dew, or fog is indicated by humidity. Humidity is determined by the temperature and pressure of the system in question. Cool air has a higher humidity than warm air when the same amount of water vapor is present. The dew point is a related metric(25).

2.1.3. Possibility of Rain
A probability of rain, often known as a chance of precipitation or a chance of rain, is a measure of the likelihood of at least some minimal amount of precipitation occurring within a given projected period. It is frequently published in conjunction with weather forecasts(26).

2.1.4. Uv Index
The ultraviolet index, sometimes known as the UV index, is an international standard measurement of the intensity of sunburn-causing ultraviolet (UV) light at a given location and time. The scale was created by Canadian scientists in 1992, and the World Health Organization and the World Meteorological Organization recognized and standardized it in 1994. I mostly utilized it in public daily predictions, but it's becoming more widely available as an hourly forecast as well(27).

2.1.5. Wind Speed (km/h)
Wind speed, also known as wind flow speed, is a fundamental atmospheric phenomenon created by air moving from high to low pressure, typically due to temperature variations. An anemometer is now routinely used to measure wind speed(28). Weather forecasting, aviation and maritime operations, construction projects, the development and metabolic rate of many plant species, and a slew of other things are all affected by wind speed.

2.2. Recording Data
This section shows the data that was recorded during this month from the weather website. The table (1) shows the results recorded for (temperature, humidity, possibility of rain, Uv index, wind speed) during the
day and night five days ago. While the table (2) shows the recorded results of (temperature, humidity, possibility of rain, Uv index, wind speed) during the night and the day as well, but on the same day.

Table 1. Recorded data from the weather website five days ago.

| Date | Temperature | Humidity | Possibility of rain | Uv index | Wind speed (km/h) | Temperature | Humidity | Possibility of rain | Uv index | Wind speed (km/h) |
|------|-------------|----------|---------------------|----------|------------------|-------------|----------|---------------------|----------|------------------|
| ١/١  | 17          | 66%      | 11%                 | 9        | 3                | 9           | 77%      | 13%                 | 0        | 8                |
| ١/٢  | 17          | 63%      | 6%                  | 9        | 3                | 9           | 75%      | 13%                 | 0        | 8                |
| ١/٣  | 17          | 62%      | 5%                  | 12       | 3                | 9           | 74%      | 13%                 | 0        | 0                |
| ١/٤  | 18          | 62%      | 4%                  | 15       | 3                | 8           | 71%      | 3%                  | 0        | 0                |
| ١/٥  | 17          | 54%      | 3%                  | 15       | 3                | 7           | 62%      | 3%                  | 0        | 9                |
| ١/٦  | 17          | 53%      | 3%                  | 12       | 3                | 7           | 63%      | 3%                  | 0        | 9                |
| ١/٧  | 17          | 52%      | 3%                  | 12       | 3                | 6           | 64%      | 3%                  | 0        | 7                |
| ١/٨  | 17          | 53%      | 3%                  | 9        | 3                | 6           | 63%      | 3%                  | 0        | 4                |
| ١/٩  | 17          | 51%      | 3%                  | 7        | 3                | 6           | 65%      | 3%                  | 0        | 6                |
| ١/١٠ | 19          | 41%      | 4%                  | 9        | 3                | 5           | 57%      | 3%                  | 0        | 7                |
| ١/١١ | 18          | 52%      | 4%                  | 10       | 3                | 6           | 61%      | 3%                  | 0        | 9                |
| ١/١٢ | 19          | 49%      | 3%                  | 12       | 3                | 7           | 61%      | 3%                  | 0        | 7                |
| ١/١٣ | 21          | 49%      | 3%                  | 9        | 3                | 6           | 65%      | 3%                  | 0        | 6                |
| ١/١٤ | 22          | 40%      | 1%                  | 20       | 2                | 11          | 50%      | 2%                  | 0        | 16               |
| ١/١٥ | 20          | 42%      | 3%                  | 23       | 3                | 7           | 56%      | 4%                  | 0        | 10               |
| ١/١٦ | 19          | 53%      | 4%                  | 11       | 4                | 7           | 62%      | 3%                  | 0        | 9                |
| ١/١٧ | 19          | 55%      | 4%                  | 12       | 4                | 8           | 60%      | 2%                  | 0        | 14               |
| ١/١٨ | 20          | 43%      | 1%                  | 19       | 4                | 7           | 53%      | 1%                  | 0        | 18               |
| ١/١٩ | 19          | 44%      | 2%                  | 18       | 4                | 7           | 55%      | 1%                  | 0        | 19               |
| ١/٢٠ | 18          | 46%      | 2%                  | 17       | 4                | 5           | 58%      | 2%                  | 0        | 21               |
| ١/٢١ | 12          | 42%      | 4%                  | 30       | 4                | 2           | 50%      | 2%                  | 0        | 22               |
| ١/٢٢ | 13          | 50%      | 2%                  | 26       | 4                | 3           | 61%      | 3%                  | 0        | 18               |
| ١/٢٣ | 14          | 50%      | 2%                  | 20       | 4                | 2           | 61%      | 2%                  | 0        | 18               |
| ١/٢٤ | 14          | 49%      | 3%                  | 12       | 4                | 2           | 61%      | 3%                  | 0        | 7                |
| ١/٢٥ | 17          | 43%      | 3%                  | 11       | 4                | 4           | 61%      | 3%                  | 0        | 9                |
| ١/٢٦ | 17          | 49%      | 4%                  | 12       | 4                | 5           | 61%      | 3%                  | 0        | 7                |
| ١/٢٧ | 21          | 40%      | 3%                  | 20       | 3                | 11          | 37%      | 3%                  | 0        | 23               |
| Date   | Temperature | Humidity | Possibility of rain | Uv index | Wind speed (km/h) | Temperature | Humidity | Possibility of rain | Uv index | Wind speed (km/h) |
|--------|-------------|----------|---------------------|----------|------------------|-------------|----------|---------------------|----------|------------------|
| ١/٨٢  | 22          | 38%      | 5%                  | 18       | 4                | 9           | 55%      | 3%                  | 0        | 16               |
| ١/٨١  | 18          | 52%      | 2%                  | 24       | 4                | 6           | 61%      | 2%                  | 0        | 15               |
| ١/٨٠  | 16          | 50%      | 2%                  | 14       | 4                | 6           | 60%      | 2%                  | 0        | 10               |

Table 2. Recorded data from the weather website in the same days.

| Date | Temperature | Humidity | Possibility of rain | Uv index | Wind speed (km/h) | Temperature | Humidity | Possibility of rain | Uv index | Wind speed (km/h) |
|------|-------------|----------|---------------------|----------|------------------|-------------|----------|---------------------|----------|------------------|
| ١/١  | 18          | 60%      | 2%                  | 8       | 3                | 8           | 69%      | 6%                  | 0        | 8                |
| ١/٢  | 18          | 61%      | 2%                  | 11      | 3                | 9           | 68%      | 5%                  | 0        | 10               |
| ١/٣  | 19          | 61%      | 2%                  | 13      | 3                | 10          | 67%      | 4%                  | 0        | 11               |
| ١/٤  | 18          | 56%      | 2%                  | 20      | 3                | 7           | 63%      | 3%                  | 0        | 14               |
| ١/٥  | 20          | 43%      | 1%                  | 9       | 3                | 5           | 60%      | 4%                  | 0        | 7                |
| ١/٦  | 17          | 52%      | 1%                  | 19      | 3                | 6           | 63%      | 3%                  | 0        | 12               |
| ١/٧  | 17          | 51%      | 1%                  | 13      | 3                | 4           | 62%      | 5%                  | 0        | 8                |
| ١/٨  | 17          | 52%      | 2%                  | 11      | 3                | 4           | 60%      | 4%                  | 0        | 9                |
| ١/٩  | 17          | 49%      | 1%                  | 10      | 3                | 4           | 59%      | 4%                  | 0        | 8                |
| ١/١٠ | 20          | 35%      | 1%                  | 11      | 3                | 4           | 57%      | 4%                  | 0        | 9                |
| ١/١١ | 17          | 53%      | 2%                  | 14      | 3                | 5           | 61%      | 4%                  | 0        | 11               |
| ١/١٢ | 19          | 44%      | 1%                  | 13      | 3                | 6           | 53%      | 2%                  | 0        | 9                |
| ١/١٣ | 21          | 46%      | 1%                  | 12      | 3                | 10          | 42%      | 2%                  | 0        | 21               |
| ١/١٤ | 21          | 54%      | 2%                  | 12      | 3                | 10          | 42%      | 4%                  | 0        | 12               |
| ١/١٥ | 15          | 63%      | 2%                  | 22      | 3                | 7           | 77%      | 7%                  | 0        | 8                |
| ١/١٦ | 18          | 68%      | 7%                  | 7       | 4                | 9           | 72%      | 8%                  | 0        | 10               |
| ١/١٧ | 19          | 64%      | 2%                  | 11      | 4                | 9           | 65%      | 4%                  | 0        | 16               |
| ١/١٨ | 17          | 50%      | 2%                  | 11      | 3                | 8           | 54%      | 4%                  | 0        | 18               |
| ١/١٩ | 16          | 42%      | 1%                  | 11      | 3                | 8           | 48%      | 1%                  | 0        | 19               |
3. Results
In this section the results will be analyzed and the amount of discrepancy in the results will be indicated. The values of the coefficient of determination will be calculated to determine the possibility of adopting these values in construction projects and making short-term decisions in construction projects.

3.1. Temperature
Temperature is usually considered one of the most important factors affecting the construction projects in addition to the structural tests. As some specifications may allow a temperature tolerance of 5 degrees Celsius during the tests. From chart 2, it is shown that the highest amount of temperature difference is 5 degrees Celsius in days. The probability of a change of 5 degrees is 3%, while the probability of a change in temperature of 1 degree is 33%. At night, the largest difference in temperature is 3 degrees Celsius. The probability of a change of 3 degrees is 3%, while the probability of a change in temperature of 1 degree is 50%.

### Table 2: Weather Conditions

| Date | Day (D) | Night (N) |
|------|---------|-----------|
|      | temperature | Humidity | Possibility of rain | Uv index | Wind speed (km/h) | temperature | Humidity | Possibility of rain | Uv index | Wind speed (km/h) |
| ١/٠٢ | 18       | 52%      | 9%       | 28 | 4 | 5           | 57%     | 5%       | 0          | 32          |
| ١/١١ | 12       | 40%      | 1%       | 30 | 4 | 3           | 52%     | 3%       | 0          | 20          |
| ١/١٢ | 13       | 56%      | 2%       | 27 | 4 | 3           | 63%     | 5%       | 0          | 18          |
| ١/١٣ | 13       | 53%      | 2%       | 23 | 4 | 1           | 64%     | 5%       | 0          | 11          |
| ١/١٤ | 14       | 47%      | 1%       | 12 | 4 | 4           | 61%     | 4%       | 0          | 7           |
| ١/١٥ | 16       | 54%      | 2%       | 9  | 4 | 5           | 63%     | 5%       | 0          | 9           |
| ١/١٦ | 17       | 54%      | 1%       | 12 | 4 | 8           | 42%     | 5%       | 0          | 12          |
| ١/١٧ | 20       | 41%      | 1%       | 17 | 4 | 13          | 36%     | 19%      | 0          | 30          |
| ١/١٨ | 23       | 41%      | 20%      | 26 | 4 | 9           | 67%     | 5%       | 0          | 12          |
| ١/١٩ | 21       | 52%      | 2%       | 26 | 4 | 8           | 61%     | 3%       | 0          | 27          |
| ١/٢٠ | 16       | 54%      | 1%       | 17 | 4 | 6           | 64%     | 3%       | 0          | 14          |
3.2. Humidity
The amount of humidity in the air may have less impact on construction projects than other weather factors. From chart 3, it can be seen that the highest amount of difference in humidity during the day and night is 21%. On the day, the probability in the humidity a change of 21% is 3%, while the probability of a change in humidity of 1% is 20%. On the night, the probability in the humidity a change of 21% is 3%, while the probability of a change in humidity of 2% is 17%.

3.3. Possibility of Rain
Chart 4 shows that the highest difference in the probability of rain during the day is 15%, but during the night it is 16%. On the day, the probability in the probability of rain a change of 15% is 3%, while the
probability of a change in the probability of rain 2% is 37%. On the night, the probability in the probability of rain a change of 16% is 3%, while the probability of a change in the probability of rain 1% is 37%.

Figure 4. Relationship between Possibility of rain with days.

3.4. Uv Index
Chart 5 shows that the highest difference in the Uv index during the day is 1, but during the night it is 14. On the day, the probability in the Uv index a change of 1 is 14%, while the probability of a change in the Uv index 0 is 86%. On the night, the probability in the Uv index a change of 14 is 3%, while the probability of a change in the Uv index 2 is 30%.

Figure 5. Relationship between Uv index with days.
3.5. Wind Speed (km/h)

Wind speed is one of the most important factors that are taken into consideration in tall structures as well as in lifting works. Chart 6 shows that the highest difference in the wind speed during the day is 11, but during the night it is 0. On the day, the probability in the wind speed a change of 11 is 3%, while the probability of a change in the wind speed 1 is 23%. On the night, the probability in the wind speed a change of 0 is 100%.

![Relationship between Wind speed (km/h) and days](image)

**Figure 6.** Relationship between Wind speed (km/h) with days.

4. Conclusions

Weather conditions are one of the important factors that must be taken into account to make a right decision in construction projects. Using weather location data in decision-making is very useful as it is easy to use and readily available for use. Through the results, it is clear that there are differences in the weather conditions, which appear clear to him, comparing the factors recorded before and after five days of the intended day. Through the study, it turns out that it is possible to rely on the location of the weather in making short-term decisions. In the case of large and accurate construction projects, relying on more accurate data may be effective, especially at important stages. It is possible to rely on a larger amount of data, which, if available, can be derived from a statistical equation to reduce this difference. It is preferable to study weather data for longer periods in order to show whether it is possible to rely on weather data in making long-term decisions and design work.

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