

# **Knowledge and Attributes Forecasting Index: Self-Assessment for Graduating Construction Management Students**

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The majority of construction management (CM) students entering the workforce do not have a clear vision of where they will fit into a range of positions available to them within the construction industry. This is in part, due to the fact they may not realize where their strengths and weaknesses reside. Surveys and interviews were used to create knowledge and traits forecasting index models, in order to provide valuable feedback for future graduates of the CM program at Roger Williams University (RWU), as to how they might fit into the architecture, engineering, and construction (AEC) industry. The results will also be used for the overall assessment of the CM program outcomes as they relate to the American Council for Construction Education (ACCE) revised standards. The research indicated that students are not always retaining the CM skills necessary to operate in the construction industry, but are stronger in possessing the character traits that contractors are looking for to fit within their company culture.

**Key Words:** Construction Management, Traits, Attributes, Competencies, Assessment

## **Introduction**

Construction companies have many choices available to them when looking to hire new construction management (CM) graduates. Across the US, there well over 100 construction or CM programs listed by the Associated Schools for Construction (ASC) or the American Council for Construction Education (ACCE), many of which are accredited by the ACCE. The accreditation gives some level of assurance to employers that graduates of these accredited programs are receiving a minimal standard of construction education. Each program has an inherent uniqueness to it regarding the knowledge and skills they teach their students to prepare them for careers in the architecture, engineering, and construction (AEC) industry. In many instances employers are an active part of the programs they hire from as participants on the programs' industry advisory board (IAB). This level of involvement allows them access (albeit indirect) to the topical content areas, body of knowledge, and skills that are taught to the CM students. Some employers rely on this connection to ensure the students they are about to hire possess the qualities they seek in their business environment. Construction contractors for the most part look at two sets of hiring criteria; CM skills such as the ability to create a construction schedule and personal traits such as leadership.

The construction industry is an ever-changing enterprise subject to a number of influences such as economic forces, changes in market share, labor management, new technologies, and government regulations. Comparable to how industry makes adjustments to influential factors, CM programs have to make similar changes to ensure their students are "job ready" upon graduation. Fortunately, for both industry and the soon-to-be graduate, the current curriculum delivered at the CM program at RWU has been built on a solid underpinning and has had great success delivering the fundamental skills required for the market and sought after by industry leaders. As the AEC industry changes, so must the CM program appropriately react and ensure that the graduates are as 'job-ready' as possible as they enter the workforce. Construction companies all have different approaches in terms of how they identify, interview, consider, and subsequently hire graduates from CM programs. This research project focused on the two

employers who historically have hired the majority of the graduates of the CM program at RWU on an annual basis and focused on their unique hiring process for graduates.

### Literature Review

The construction industry is in a constant state of change because of economics, market forces, labor resources, new technologies, and government regulations. Similar to the industry, CM programs have to mirror these changes to ensure their students are “job-ready” upon graduation (Benhart & Shaurette, 2011). Companies have different ways of going about assessing graduates from CM programs as to whether or not they would become a valuable asset and a long-term employee. The challenge of finding qualified employees and growing employer recognition of the value of a management background has expanded the opportunity for construction programs to supply graduates to this market (Ryan & Sobharaksha, 2004). Construction companies place differing levels of value on skills, competencies, traits, and attributes. Some companies gravitate toward a very structured, almost scientific assessment such as the use of the Predictive Index. The Predictive Index® (PI®) is a theory-based, self-report measurement of normal, adult, work-related personality that has been developed and validated for use within occupational and organizational populations (Predictive Index, 2014). The PI measures four primary and fundamental personality constructs: (1) *Dominance*: the degree to which an individual seeks to control his or her environment; (2) *Extroversion*: the degree to which an individual seeks social interaction with other people; (3) *Patience*: the degree to which an individual seeks consistency and stability in his or her environment and (4) *Formality*: the degree to which an individual seeks to conform to formal rules and structure.

At recent meetings of the ACCE, a multidisciplinary group of academics, have been working toward the goal of developing and prioritize a list of competencies or learning outcomes that could be applied to construction education programs. During one local session, the top competencies focused on effective communication skills, including “apply communication skills to function effectively in a diverse team.” This process has been replicated in a series of national meetings, and the results are currently being distilled into a draft set of student learning outcomes by the ACCE. Contractors are increasingly put more weight into assessment of the soft skills (traits and attributes) as a measure of assessing an incoming graduate. Written and oral communication skills have become increasingly important in the construction industry (Bureau of Labor Statistics, 2010). Not all CM programs take the same approach in helping students develop these soft skills. Engineering and construction programs have taken many different approaches to developing students’ communication skills. Some programs have included liberal arts subjects in their curricula while others have integrated communication throughout the curriculum (McGregor, 2000). Communication skills, both oral and in writing, present different sets of challenges to CM faculty in trying to help students develop these skills over the course of their academic career. Written communication capabilities are critical to effective engineering and construction education, but many undergraduate programs have grappled with delivering effective professional communication skill development in their curricula (Plumb & Scott, 2002). The greatest challenge seems to be to align the interests between industry and the CM faculty. To determine new and evolving concepts and trends, it should be considered that the perceptions between industry and academia might be different. Some studies show that there is a discrepancy between what the industry wants and what the higher education offers (Chileshe & Haupt, 2007). It is not difficult to see how each entity views the importance of traits and attributes. Ultimately faculty must utilize performance outcomes driven by industry needs for program evaluation (Anderson and Anderson, 1995).

## Objectives and Hypothesis

The objective of the research was to develop a knowledge and traits forecasting index to help CM students that are soon to graduate, gauge where and how they may fit into a company's organization structure and by extension, their future career possibilities. The hypothesis ( $H_0$ ) of this research is that graduating CM students may not realize what their future employers deem to be the most important attributes, skills, and/or knowledge they will need to succeed within a given organization.

## Methodology

The research was conducted in three phases: Phase I – interview senior management from the two target companies; heretofore referred to as Company A and Company B who historically have hired the largest number of graduates from the CM program at RWU; Phase II – Qualtrics survey to graduates (alumni) of the program; and Phase III – follow-up hard copy surveys to industry professionals at the fall career fair.

## Results and Discussion

### *Phase I*

The results of the Phase I interviews with Companies A and B revealed some surprising findings that were not generally known to the authors. The following is a summary of comments garnered via the interview process:

#### Company A

- “We hire for character”
- “We try to determine throughout the interview process whether or not the potential hire possesses a range of traits such as:
  - Leadership skills,
  - A passion for the construction industry
  - Problem-solving skills; i.e. do they have an analytical approach when presented with an issue on construction project
- Small groups of potential hires from various universities are put together and given problems to solve to see how they react with each other and how they work together as a team to determine potential solutions to a common problem
- Potential hires are put on an actual jobsite for a day and asked “scenario” questions of how they would solve typical construction issues
- “Building Information Modeling (BIM) is becoming a prerequisite skill for the graduating CM student”
- “Graduates need to learn or be acutely aware of LEAN construction techniques”
- “Graduates need to be familiar with new project delivery methods such as Integrated Project Delivery (IPD)”
- “Graduates need to know how to build a schedule; not just be fluent in the scheduling software”
- “Graduates need to be very familiar with how the building parts and systems go together”; i.e. means and methods
- “Graduates need to know how to perform a quantity takeoff”
- “Graduates need to display an attention to detail”

#### Company B

- The company assumes that the potential employees know the basic CM skills required in the industry when they graduate from the CM program and that assumption has not been disproved, to date, how the following were highlighted as important during the interview:

- Building Information Modeling
  - Revit
  - Lean construction
  - Digital document management
- The PI index evaluation they administer concentrates on evaluating the candidate against four character criteria:
  - Dominance – take charge, move the team forward in a group setting
  - Extrovert Tendencies – works well in a group, likes the group setting
  - Level of impatience – wants to get things done – now. Friday evening is preferable to Monday morning
  - Attention to Detail – checks, observes, corrects
- During the interview process the candidates are evaluated on the following characteristics:
  - Energy level
  - As a student did they extend themselves – campus/club officer, summer internships, academic achievement, and self-promotion?
  - What summer jobs did they take and how did that prepare them for a career in CM?
  - Did they rise to any challenges?
  - Does the candidate demonstrate leadership?
- A big part of the interview process is determining the communications skills:
  - How does the candidate write and speak?
  - Is the candidate convincing?
  - Is the candidate likeable?
  - Can the candidate manage a group?
  - One thing that leapt out during the conversation is the emphasis on the students' ability to communicate in writing and orally. Valued skills are the ability to transmit unambiguous information and to persuade people to do what they are ordinarily not inclined to do
- The candidates are placed in situations such as problem solving, group problem solving, group leadership skills demonstration, etc.
- Administers a Predictive Index (PI) test to track the persistence of new hires; results indicate < 5% rejection rate

The results clearly indicate the two target companies have very different criteria assessment methods to determine whether or not they will hire a CM graduate but they both place a high value on a potential hire having strong character traits. They also identified similar CM skills such as Lean construction, BIM, and quantity takeoffs to be of significance. The information collected in the Phase I interviews was used to develop and structure the Phase II survey

### *Phase II*

A two-part survey was administered to graduates (alumni) of the CM program. In Part 1 the respondents were asked to what degree the CM program prepared them in specific construction management skills (competencies) and Part 2 asked them how they perceived themselves possessing specific attributes and traits at the point of graduation. With a response rate of 57% the survey results are as follows:

Table 1.

**Part 1 & 2; Alumni Survey Results (n = 23)**

| <b>As a graduate of the CM program at RWU, I feel my education:</b>                   | $\mu$       | $\sigma$ | $\sigma^2$ |
|---------------------------------------------------------------------------------------|-------------|----------|------------|
| Taught me the necessary skills to create construction schedules                       | 4.32        | 0.51     | 0.72       |
| Taught me how to perform a quantity takeoff                                           | 4.23        | 0.28     | 0.53       |
| Taught me the use of BIM software such as Revit                                       | 3.32        | 0.80     | 0.89       |
| Taught me the basics of Lean Construction                                             | 3.18        | 0.92     | 0.96       |
| Helped me understand the Integrated Project delivery (IPD) method and its application | 3.86        | 1.08     | 1.04       |
| Appropriately exposed me to digital document management software                      | 3.41        | 1.11     | 1.05       |
| Taught me the importance of “means & methods” in the construction process             | 4.23        | 0.37     | 0.61       |
| Gave me a good understanding of cost control methods                                  | 4.14        | 0.41     | 0.64       |
| Gave me a good understanding of an effective construction safety program              | 4.36        | 0.24     | 0.49       |
| <b>Average</b>                                                                        | <b>3.89</b> | -        | -          |
|                                                                                       |             |          |            |
| <b>At the time of graduation, I feel I possessed the following traits:</b>            | $\mu$       | $\sigma$ | $\sigma^2$ |
| Leadership                                                                            | 4.41        | 0.44     | 0.67       |
| Worked as an effective member of a team                                               | 4.68        | 0.23     | 0.48       |
| Communicate effectively orally                                                        | 4.55        | 0.35     | 0.60       |
| Communicate effectively in writing                                                    | 4.36        | 0.43     | 0.66       |
| Take-charge attitude to get the job done                                              | 4.32        | 0.51     | 0.72       |
| Understand time is of the essence (sense of urgency)                                  | 4.32        | 0.70     | 0.84       |
| Manage my time effectively                                                            | 4.27        | 0.30     | 0.55       |
| Shows attention to detail                                                             | 4.36        | 0.34     | 0.58       |
| Analytical in my problem-solving approach                                             | 4.23        | 0.56     | 0.75       |
| <b>Average</b>                                                                        | <b>4.39</b> | -        | -          |

Notes to table:

1. [Scale: 1=strongly disagree; 2=disagree; 3=neither agree nor disagree; 4=agree; 5=strongly agree]
2. Alumni base is extensive but getting responses to this survey was not as high as anticipated

The results of the survey indicate the students felt they were significantly stronger in the character traits than the CM skills at the time of graduation and that more emphasis needs to be placed on a number of construction topics to include but not limited to lean construction, BIM, digital document management software, and a greater understanding of IPD. Overall the respondents felt they were well-prepared for the CM skills contractors are looking for.

### Phase III

The Phase III data was extracted from a survey developed for use by the office of Career Services and was administered at the fall career fair. Table 2 represents only responses from the contractors at the career fair and only from questions relevant to this research. The respondents were asked to evaluate six different employee assessment metrics by indicating their level of importance as low (*l*), medium (*m*), or high (*h*). They were also asked to rank (*r*) order the metrics in order of importance (see Table 2).

Table 2.

**Phase III Survey Results (n = 6)**

|                                                       | Contractors |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-------------------------------------------------------|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
|                                                       | A           |          |          |          | B        |          |          |          | C        |          |          |          | D        |          |          |          | E        |          |          |          | F        |          |          |          |
| Hiring Criteria                                       | <i>r</i>    | <i>l</i> | <i>m</i> | <i>h</i> | <i>r</i> | <i>l</i> | <i>m</i> | <i>h</i> | <i>r</i> | <i>l</i> | <i>m</i> | <i>h</i> | <i>r</i> | <i>l</i> | <i>m</i> | <i>h</i> | <i>r</i> | <i>l</i> | <i>m</i> | <i>h</i> | <i>r</i> | <i>l</i> | <i>m</i> | <i>h</i> |
| Industry experience – internships                     | 2           |          |          | √        | 4        |          |          | √        | 5        |          | √        |          | 1        |          |          | √        | 1        |          |          | √        | 2        |          |          | √        |
| Presentation ability – ability to project personality | 3           |          |          | √        | 2        |          |          | √        | 2        |          |          | √        | 3        |          |          | √        | 3        |          | √        |          | 4        |          |          | √        |
| Work ethic, seriousness of purpose, maturity          | 1           |          |          | √        | 1        |          |          | √        | 1        |          |          | √        | 4        |          |          | √        | 2        |          |          | √        | 1        |          |          | √        |
| Computer skills in software specific to your industry | 6           |          | √        |          | 5        |          | √        |          | 3        |          |          | √        | 5        |          |          | √        | 4        |          | √        |          | 5        |          | √        |          |
| Knowledge of Basics – Technology & Management         | 5           |          | √        |          | 3        |          |          | √        | 6        |          | √        |          | 6        |          |          | √        | 5        |          | √        |          | 3        |          |          | √        |
| Grade point average (GPA)                             | 4           |          | √        |          | 6        |          | √        |          | 4        |          | √        |          | 2        |          |          | √        | 6        |          | √        |          | 6        |          |          | √        |

The Phase III survey results indicate the following rank of the six hiring criteria: (1) work ethic, seriousness of purpose; (2) internships; (3) presentation ability; and tied for (4) computer skills specific to the industry, GPA, and knowledge of basics in technology and management. The results, to some degree, support what the respondents revealed in the Phase I survey.

### Knowledge Forecasting Index ( $K_{FI}$ )

The first key outcome of the research was the development of the knowledge forecasting index ( $K_{FI}$ ), which measures a range of construction knowledge areas (skills or competencies) that construction companies who hire from the CM program deem important for the potential hire to possess, in order to function as a construction manager within their respective firms (see Table 3).

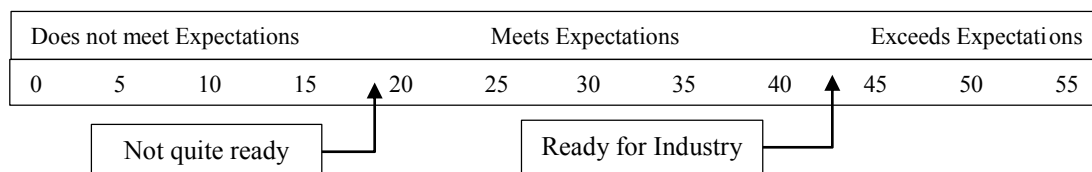
Table 3.

***K<sub>FI</sub> Self-Assessment Model***Instructions

1. Please indicate for each statement your perception of how well you achieved the specific CM competency
2. *Weighting Factor*: Please indicate “S” (for student) if you feel you could have improved a competency with more effort on your part or “F” (for faculty) if you feel the competency would have been improved with more effort from the CM faculty.

| CM Competency                                              | Strongly<br>Disagree =<br>1 | Disagree =<br>2          | Neither<br>agree nor<br>disagree = 3 | Agree =<br>4             | Strongly<br>agree = 5    | S                        | F                        |
|------------------------------------------------------------|-----------------------------|--------------------------|--------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| a. Create a construction schedule                          | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Perform a quantity takeoff                              | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Create an estimate                                      | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Utilize BIM software                                    | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e. Understand the basics of Lean construction              | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f. Understand the use of Integrated Project Delivery (IPD) | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| g. Utilize digital document management software            | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| h. Understand the importance of “means & methods”          | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| i. Understand cost control methods                         | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| j. Understand the elements of a construction safety plan   | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

To create a forecasted score for each competency a weighting factor was applied to produce a set number. If the students indicated that a competency would have been higher with more effort on their part they checked “S” and the competency was multiplied by 0.90 [ $\sum a_j * 0.90$ ]. If the students indicated that a competency would have been higher with more effort on the part of the CM faculty, they marked ‘F’ and the competency was multiplied by 1.10 [ $\sum a_j * 1.10$ ]. Although the weighting factors seem somewhat arbitrary, they were selected to represent the idea that the authors believe faculty can always do a little more to improve the teaching-learning dynamic and therefore placed a higher importance on the effect of the weighting factors (see Figure 1).

Figure 1. K<sub>FI</sub> Self-Assessment Ranking

The weighted scores for each competency would then totaled to produce a final score for a student to use in their self-assessment. Students filling out the assessment had no knowledge of the weighting influence or scoring system. The final assessment score will then be placed on the assessment scale illustrated in Figure 1.

### Attributes Forecasting Index (A<sub>FI</sub>)

The second key outcome of the research was the development of the attributes forecasting index (A<sub>FI</sub>), which measures a wide range of personal attributes or character traits that construction companies who hire from the CM program deem important in predicting the future success of newly hired CM graduates within their respective firms (see Table 2). The self-assessment as outlined in Table 4 will be administered to the 2015 graduating class of CM students in conjunction with the CM senior exit survey, as part of the overall program assessment process.

Table 4.

#### *A<sub>FI</sub> Self-Assessment Model*

##### Instructions

Indicate your perception of how well you possess each trait or attribute at the time of graduation from the CM program.

| Attribute or Trait                           | Neither                  |                          |                           |                          |                          |
|----------------------------------------------|--------------------------|--------------------------|---------------------------|--------------------------|--------------------------|
|                                              | Strongly<br>Disagree = 1 | Disagree = 2             | Agree nor<br>disagree = 3 | Agree = 4                | Strongly<br>Agree = 5    |
| a. Leadership                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Work as an effective member of a team     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Communicate effectively in writing        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Communicate effectively orally            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/> |
| e. Take charge attitude to get the job done  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/> |
| f. Sense of urgency                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/> |
| g. Manage my time effectively                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/> |
| h. Show attention to detail                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/> |
| i. Analytical in my problem-solving approach | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/> |

Note to table: The scores for all of the attributes and traits were summed [ $\sum a-i$ ] to produce a total score which can then be evaluated on a scale as illustrated in Figure 2.

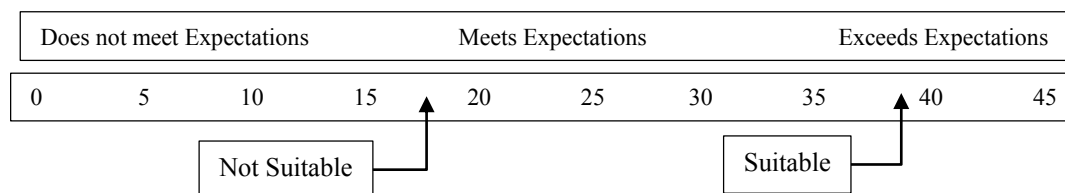


Figure 2. A<sub>FI</sub> Self-Assessment Ranking



## ACCE Student Learning Outcomes

The competencies listed in Table 1 are an amalgamation of the Student Learning Outcomes (SLO) of the revised (ACCE) standard approved in 2014 and those identified in the Phase I interviews. Since the ACCE will be putting a greater emphasis on program assessment with the implementation of the new standards, the  $K_{FI}$  and  $A_{FI}$  models can be utilized in the overall assessment of the program outcomes. In addition, some of the competencies shown in Table 4 one can be directly aligned with the ACCE SLO's.

## Conclusions

Graduating students felt they were well prepared in the character traits category and are somewhat aware of what is important to a future employer; therefore the hypothesis is not fully supported. Their preparation for the CM skills was stronger than anticipated but more emphasis needs to be placed on BIM, digital document management, and lean construction; topics employers felt were important in the future. It is expected that CM students who are about to graduate will participate in the self-assessment survey to help them better understand their strengths and weaknesses as measured against the expectations of their future employers. The results can be shared with individual students or the CM faculty can use the results of the student's self-assessment as a measure of program assessment to improve the quality of the program, if the response rate is high enough to deem the data valid.

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