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# Relationship between Undergraduate GPA and Associate Constructor (AC) Exam Scores of Construction Management Students

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Construction industry needs skilled workers, and professional certification is a way to get them. Senior level construction management (CM) students can take Associate Constructor (AC) exam as one of the first certifications as they transition into the industry. However, fewer graduating students are AC certified. The value of certifications and increasing popularity of the AC exam can motivate students to take the exam to gain professional credential and recognition. Also, the exam being reflective of the CM curriculum can motivate students to get certified. Therefore, this research assessed the correlation between undergraduate GPA (UGPA) and AC exam scores of CM seniors. The hypothesis was that there would be a positive relationship between UGPA and AC exam scores. The independent variable was UGPA while the dependent variable was the AC exam score. SAS studio facilitated the statistical analysis of the data obtained from an accredited CM undergraduate program in the south eastern part of the USA. The result showed a strong positive correlation between the scores thereby supporting the hypothesis. It was concluded that CM students needed to consider AC exam as one of the certifications as they go into the construction industry especially when their academic performances are good.

**Key Words:** Associate Constructor (AC) Exam, Construction Management, GPA

## Introduction

Construction industry is one of the industries contributing to the national economy. It is estimated to be about 9% of the gross domestic product (Bureau of Economic Analysis, 2021). With this contribution, it is also one that experience lack of skilled or professional workers. Barrows et al. (2020) states that there is a growing need for skilled and proficient construction professionals to ensure that project goals are met and delivered within budget, safety, and on time. The 2020 Construction Outlook Survey by the Associated General Contractors of America (AGC) found out that about 80% of construction firms have trouble filling both salaried and hourly craft positions, and about 70% foresee labor shortages to be the biggest problem in the next coming years. This will result in overstretched skilled workers, delays in project completion and increased project costs.

Continuous training and professional certifications are possible ways to ensure that those transitioning into the construction industry have the skills and ability to meet the demands of the growing field. Coglianese (2018) posits that the industry has established certifications that verify knowledge, ethics and expertise of those who acquire them and that these certifications are varied in such a way that students entering the industry become overwhelmed on which certifications to spend their money and time on. Associate Constructor (AC) by the American Institute of Constructors (AIC) is one of the certifications available to students with training argued to be mainly from the 4-year CM curriculum.

AIC was formed in 1971 to advance professionalism and ethics of the constructional professionals (AIC, 2022a; Burgett, 2018; Sylvester, 2012). In 1993, the AIC formed the Constructor Certification Commission to administer the beginning level of professionalism through AC examination-also called level 1 certification, and advanced level of professionalism called the Certified Professional Constructor (CPC) examination-also called level 2 certification. The commission started giving the exams in 1996 and has certified more than 25,000 people in either AC or CPC since then (Burgett, 2018). Those wishing to take the exam must qualify by either having 4 years of CM degree or 4 years of construction industry field experience and then become certified after passing the exam (AIC, 2022a). Credentialed ACs are individuals with skills and knowledge in managing the construction process and they bring value to projects as they have verified skills and knowledge level that is based on a nearly 26-year-old body of knowledge that continues to develop (AIC, 2022b). CPCs are those with the highest level of certification in the constructor certification program. They are more experienced in managing projects and give the project owners the peace of mind that their projects are being managed efficiently and effectively (AIC, 2022b).

The benefits of these certifications to the construction industry, employers and construction professionals are driving the growth and popularity of the CPC and AC exams (Ford et al., 2012; Bruce et al., 2008). To the constructor, it enhances individual's image, increases self confidence that they have met a national standard of professional practice and provides a recognized professional credential indicating a high level of skill and knowledge of the construction process. To the employer, these credentials provide the company with a competitive marketing edge by showing the employer's dedication to the professionalism of its employees. To project owners, it provides a higher assurance that the project is being managed efficiently by a skilled, ethical and professional team (AIC, 2022a).

This current research focused on the employee's side especially the senior level CM undergraduates who would like to transition into the construction industry after graduating successfully. Usually, students are to take the AC exam in their senior year after completing the CM curriculum. This is because the exam is taken to be reflective of the curriculum content of most CM education programs. The American Council for Construction Education (ACCE) as an accrediting body for CM educational programs ensures that the quality of a construction program is high through extensive evaluation and award of accreditation, and this can be used to standardize the curriculum which leads to standardized AC exam items that reflect the needs of the industry.

As noted by Coglianese (2018) and Bruce et al. (2010), there are many reasons someone can choose to get certifications, e.g., desirable position, salary boost, or prestige. These reasons can also serve as motivating avenues for CM seniors to take AC certification. Completion of CM curriculum can motivate students towards AC certification since the exam is aligned with the curriculum. For example, senior students may be inclined to pursue the certification if their academic performance are good as shown by cumulative GPA at or above 3.0 showing good mastery of the CM curriculum. This approach may increase the motivation level which culminates in seeing more young credentialed professionals getting into the construction field thereby improving the overall image of the industry.

Therefore, this research investigated the relationship between academic performance of CM students and their AC exam scores. The outcome of this study was expected to encourage students to pursue AC certification as they get into the construction industry. Literature review section follows to discuss value of certifications, correlation studies and motivation of students towards AC certification.

## Literature Review

### *Value of Certifications in the Construction Industry*

According to AIC (2022b), certification is a voluntary third-party organization process to recognize the education or experience of an individual who meets certain criteria. These certifications continue to increase in number with the evolvement of the construction industry (Barrows et al. 2020). Noteworthy, certification need to be distinguished from licensure. According to Coglianese (2018) and Barrows et al. (2020), professional licenses are usually needed to practice in certain professions such as law, architecture or engineering where the professionals must meet the required standards of care while certification is not required to practice a profession but shows competence and provides a high level of assurance that the professional will fully complete the project. The value of certification is seen when the profession and public accept and benefit through better salaries and improved image or better quality of projects delivered by those certified (Barrows et al., 2020; Clevenger et al., 2017).

El Debs et al. (2016) on the importance of certifications to recent graduates found out that safety certifications (OSHA-10hr and OSHA-30hr) and sustainability certifications were ranked highest by industry personnel surveyed. Barrows et al. (2020) focused on the value of certifications in seeking employment where it showed that PMP certification was most valued in senior project management levels followed by LEED AP. OSHA trainings were most valuable to project engineers and project managers. Even though AC certification did not feature in the valued list, it was the second cheapest considering the total cost incurred to obtain and maintain certifications. Coglianese (2018) also investigated the value of certifications through survey of newly graduated CM students and found out that safety with OSHA training displayed highest value. AC certification showed neutral to little value. Noteworthy is that these studies relied on opinion surveys to determine certification value.

### *AC Examination and Correlational Studies*

According to AIC (2022b), AC exam is an 8-hour exam administered in late fall and spring semesters annually, and comprises of 300 multiple choice questions which are weighted in 10 content areas of the AC exam study guide:1. Communication skills, 2. Engineering concepts, 3. Management concepts, 4. Materials, methods, and project modeling and visualization, 5. Bidding and estimating, 6. Budgeting, costs, and cost control, 7. Planning, scheduling, and schedule control, 8. Construction safety, 9. Construction geomatics(surveying), and 10. Project administration. These content areas mimic the CM curriculum in many ways and so students who take and pass AC exam are assumed to have knowledge and mastery of CM education curriculum content. For assurance of quality and standardization, the exam is accredited by the American National Standards Institute (ANSI) and also includes the industry professionals in the team to assess the exam questions (submitted by educators) for relevance before they are integrated in the final exam packet for students to take (Burgett, 2018; AIC, 2022a). The passing score is 70% or higher which is equivalent to a score of 210 or more in the exam (AIC, 2022a). The exam is either paper based or computer-based at an approved exam site.

Correlational research about the UGPA and AC exam are rare. Ford et al. (2012) conducted a study measuring educational program's effectiveness using the AC exam. In actuality, the study predicted AC exam using SAT scores (combined math/verbal scores) of 160 CM students at Western Carolina University. The results showed a correlation of 0.60. Another correlational study by Sylvester (2012) at Western Kentucky University investigated student's grade point average (GPA) success in passing the AC exam from the year 2004 to 2009. The study divided the 81-student cohort into four GPA range categories and mapped GPA to the AC exam. The results showed the higher (3.5-3.9) GPA grouping led to a higher pass rate at 67% with no linear correlation with GPA (Sylvester, 2012; Bradford et al., 2019). With these, the current study explores AC certification using the latest dataset.

### *Performance and Motivation*

Performance refers to a behavior towards a goal. It is always assumed that those who excel are very serious and complete their work in high standing. They accomplish their full academic tasks, earn excellent grades, and are able to graduate successfully. Their performance mirrors the three types of knowledge: declarative knowledge, procedural knowledge, and motivation (Kuncel et al., 2001; Wao et al., 2016). Declarative knowledge refers to realizing what to do when faced with a problem and finding a solution while procedural knowledge refers to ability to complete a task. Motivation is the drive to complete the task. That is, the persistence to act in a way to ensure excellence (Kuncel et al., 2001; Wao et al., 2016). Performance in the undergraduate level as measured by UGPA needs the two types of knowledge but motivation component may need strengthening especially for the AC exam.

Overall, no current study (within the last 2 years) has investigated the association of AC exams and undergraduate students' performance as measured from their GPAs. This gap has motivated conducting a correlational study to help bridge this gap with a relatively current dataset.

## Research Methods

The study investigated the relationship between the AC certification exam performance and undergraduate academic performance of CM students. The data were conveniently sourced from an ACCE accredited CM undergraduate program in the south eastern part of the USA. Data analysis using SAS studio employed descriptive statistics, correlation analysis and trend analysis. Descriptive statistics comprising of mean, mode, median, standard deviation, maximum and minimum, and distribution plot showed the nature of the distributions and variations of the AC exam and UGPA scores. Correlation analysis determined the nature and strength of the relationship between the scores. Trend analysis assessed the existence of upward mobility or downward trend in the correlation indices over the semesters the AC exam was taken. Specifically, increasing trend would imply a better relationship while a decrease implies lower level of relationship between the scores. It was hypothesized that a positive relationship existed between the scores where those who scored high GPAs would be expected to perform well in the AC exam.

The original dataset before data screening consisted of 260 CM seniors who took the AC exam. The dataset showed 5 zero (0) scores on the AC exam and these were then removed. One of the reasons for such scores was that a student went into the exam room and left without attempting the test, or some missed the test. After data screening, the sample size was 255 which were used in the analysis. The data comprised of AC and GPA scores of those who graduated from Fall 2015 to Spring 2019. Usually, the AC exam score is 300 as the maximum score with 210 as the passing score (70%). For this data, AC exam scores ranged from 144 to 274. The highest GPA score was 3.93 with 2.15 as the

lowest score. CM students were encouraged over their academic career to maintain a 3.0 cumulative GPA in order to graduate in good academic standing. Also, the students were required to pay for the AC exam and would be reimbursed their registration fees if they passed. The independent variable was the cumulative UGPA at graduation. The dependent variable was the AC exam score. UGPA was used because it gives the academic performance of a student and AC exam score reflects level of mastery of the CM curriculum which mimics construction industry requirements and proficiency.

## Results

### *Descriptive Statistics*

Descriptive statistics comprising of mean, mode, median, standard deviation, kurtosis, skewness, and minimum and maximum values were calculated for the variables and shown in table 1.

Table 1

Descriptive statistics of UGPA and AC certification exam scores

| Var. | N | Mean | Median | Mode | Std | Skew | Kurt | Min | Max | Distribution plot |
|---|---|---|---|---|---|---|---|---|---|---|
| UGPA | 255 | 3.29 | 3.35 | 3.47 | 0.37 | -0.68 | 0.07 | 2.15 | 3.93 | Negatively skewed with 3 outliers |
| AC | 255 | 234 | 237 | 252 | 22.40 | -1.02 | 1.49 | 144 | 274 | Negatively skewed with 6 outliers |

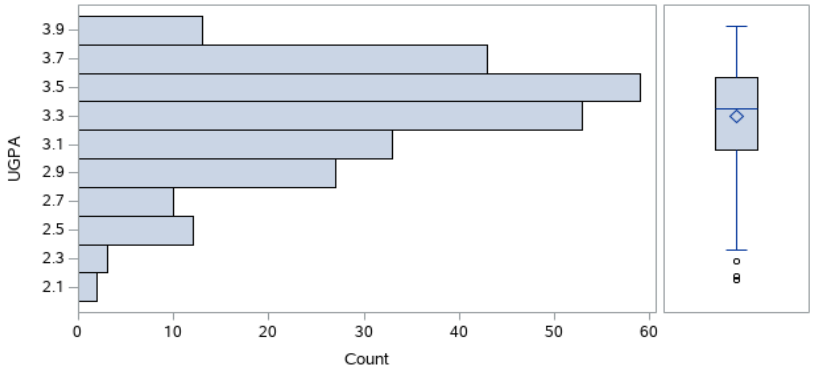



Figure 1. Distribution plot for UGPA scores.

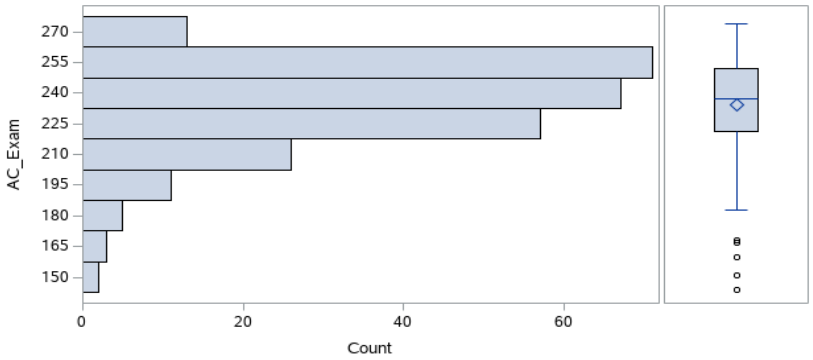



Figure 2. Distribution plot for AC certification exam scores.

In Table 1, Figure 1 and Figure 2, the distribution of UGPA and AC exam scores for all the students were negatively skewed implying that students tended to perform well with most of their scores clumping up on the upper side of the test score scale. Noteworthy is that there were some outliers which tended to fall way down below the passing score. Table 2 also gives the statistics by semesters.

Table 2

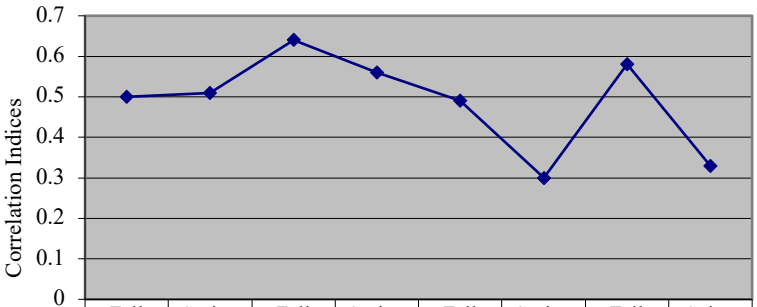
Descriptive statistics of UGPA and AC exam scores as differentiated by semester

| Semester | Variable | N | Mean | Median | Mode | Std Dev | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| Fall 2015 | UGPA | 17 | 3.08 | 3.23 | 3.24 | 0.32 | 2.28 | 3.48 |
| Spring 2016 | UGPA | 35 | 3.32 | 3.41 | 3.19 | 0.33 | 2.54 | 3.87 |
| Fall 2016 | UGPA | 27 | 3.27 | 3.29 | 3.45 | 0.36 | 2.50 | 3.81 |
| Spring 2017 | UGPA | 36 | 3.14 | 3.18 | 3.05 | 0.35 | 2.37 | 3.74 |
| Fall 2017 | UGPA | 21 | 3.36 | 3.53 | 3.25 | 0.43 | 2.18 | 3.92 |
| Spring 2018 | UGPA | 47 | 3.28 | 3.38 | 3.47 | 0.43 | 2.15 | 3.90 |
| Fall 2018 | UGPA | 31 | 3.39 | 3.34 | 3.19 | 0.25 | 2.83 | 3.92 |
| Spring 2019 | UGPA | 41 | 3.42 | 3.53 | 3.60 | 0.38 | 2.36 | 3.93 |
| Fall 2015 | AC Exam | 17 | 231.35 | 230.00 | 219.00 | 19.80 | 184.00 | 262.00 |
| Spring 2016 | AC Exam | 35 | 237.57 | 247.00 | 252.00 | 25.37 | 144.00 | 268.00 |
| Fall 2016 | AC Exam | 27 | 237.33 | 237.00 | 207.00 | 20.98 | 197.00 | 274.00 |
| Spring 2017 | AC Exam | 36 | 232.78 | 234.50 | 220.00 | 22.86 | 167.00 | 264.00 |
| Fall 2017 | AC Exam | 21 | 227.76 | 228.00 | 222.00 | 17.49 | 196.00 | 259.00 |
| Spring 2018 | AC Exam | 47 | 230.47 | 240.00 | 229.00 | 27.86 | 151.00 | 270.00 |
| Fall 2018 | AC Exam | 31 | 231.16 | 236.00 | 236.00 | 16.82 | 183.00 | 257.00 |
| Spring 2019 | AC Exam | 41 | 240.83 | 244.00 | 221.00 | 19.15 | 188.00 | 167.00 |

Table 2 shows that most students were taking the exam in the spring. Of the 255 who took the exam, 35 failed, about 14% (35/255*100%) failing rate. This implies that about 86% passed on average.

## *Correlation between AC Exam Scores and UGPA Scores*

Correlation analysis investigated the nature and strength of the relationship between UGPA and AC exam scores for those students who completed their undergraduate CM degree and also took AC exam. Using the modified Pearson correlation coefficients guide from Wao et al. (2017), the interpretation of correlation indices are; +/- 0.7 and higher = very strong positive/negative relationship, +/- 0.4 to 0.69 = strong positive/negative relationship, +/-0.3 to 0.39 = moderate positive/negative relationship, +/-0.2 to 0.29 = weak positive/negative relationship, +/-0.1 to 0.19 = very weak relationship and +/-0.01 to 0.09 = negligible relationship. This implies that the results ranged from moderate positive to strong positive relationships. Figure 3 shows the trend of the correlation indices assessed over the semesters. The sample size for each semester is also shown.




| | Fall 2015 (N=17) | Spring 2016 (N=35) | Fall 2016 (N=27) | Spring 2017 (N=36) | Fall 2017 (N=21) | Spring 2018 (N=47) | Fall 2018 (N=31) | Sping 2019 (N=41) |
|---|---|---|---|---|---|---|---|---|
| UGPA vs AC Exam | 0.5 | 0.51 | 0.64 | 0.56 | 0.49 | 0.3 | 0.58 | 0.33 |

Figure 3. Correlation coefficients of UGPA and AC exam score of the students.

The graphical trend plot in Figure 3 shows the relationship between UGPA and AC exam as relatively modest/strong positive correlation indices. Noteworthy, it would be useful to assess the overall correlation coefficient that aggregates all the scores of the two variables for all the students over the duration. Thus, a correlational of 0.436 (r = 0.436) was found to exist between the scores at a *p*-value ($p<0.0001$) for the 255 students over the 4-year duration of the study. Figure 4 shows the scatter plot.

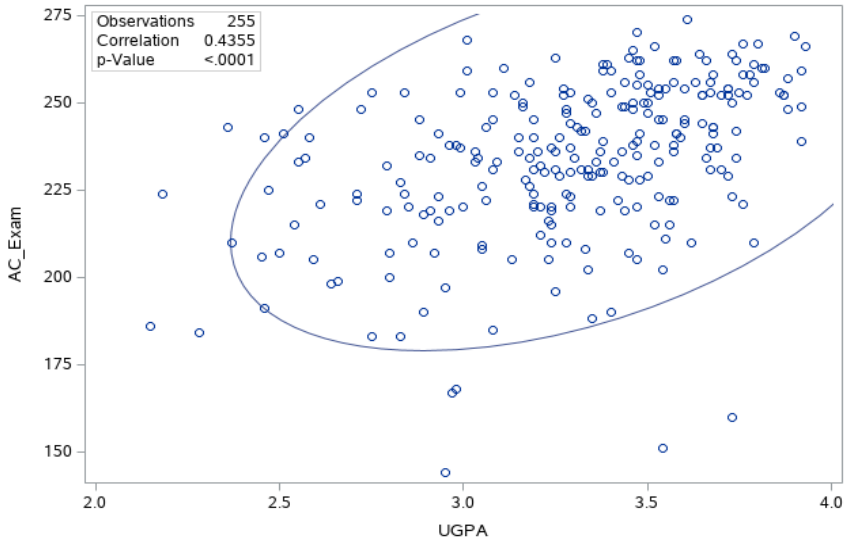



Figure 4. Scatter plot of AC exam scores and UGPA scores of the students.

Somewhat similar *p*-values were seen for the correlation values over the semesters in Figure 3 (Fall 2015, $p = 0.0397$; Fall 2016, $p = 0.0003$; Fall 2017, $p = 0.0228$; Fall 2018, $p = 0.006$; Spring 2016, $p = 0.0018$; Spring 2017, $p = 0.0004$; Spring 2018, $p = 0.0387$; Spring 2019, $p = 0.0368$). These *p*-values (including one for the total number of students) were statistically significant at $p = 0.05$. Interpretation of the *p-value* is to reject the null hypothesis when *p-value* is less than 0.05 implying a statistically significant difference in the result or fail to reject the null hypothesis if *p-value* is greater than 0.05 suggesting insufficient information to reject the null hypothesis. Therefore, it is clear from the statistically significant correlational results that the performance in AC exam relates well with UGPA.

## Discussion and Conclusion

Review of literature has shown that professional certifications have been on the rise to meet the growing need for skilled workers and also that qualified people are needed in projects. Value of certifications to students has been documented, e.g., better salaries, professional image, etc. AC certification has been identified to be available to CM students which they can use to demonstrate that they have the basic professional knowledge and competence needed to handle projects when they pass the exam. Students need the knowledge gathered over their 4-year CM education career as a prerequisite to take the exam. The knowledge as depicted from academic performances, which is measured by their GPAs, can be used as a motivating factor to pursue certification before going into the construction field. Relative cheapness of the AC exam compared to other certifications can also be a source of motivation. Passing it would imply that an individual is ready for the construction field.

Therefore, this research explored the relationship between the cumulative GPA and the AC exam of CM seniors. The idea was that those who excelled in the exam by achieving the passing score of 70% and above would be construed to have mastered the CM curriculum which is reflective of the industry needs with regard to the skills needed for the growing workforce. Statistical results were reported.

The performance in the AC exam was found to be relatively high as depicted by the negatively skewed distributions of the scores. Similar result was seen in the UGPAs. With the 35 students failing the AC exam, it was deduced that the success rate was at 86%. This is higher when compared with the study by Braford et al. (2019) and Sylvester (2012) where 67% pass rate was recorded in AC exam but surprisingly with no linear correlation with GPA. This 86% success rate in the exam was a clear sign that students were getting highly motivated to take and pass the exam. This result showed a statistically significant strong correlation with UGPA which implied that if students performed well academically in the CM curriculum, there was a higher likelihood that they would perform equally well in the AC exam and have the AC credential when they transition into the construction industry especially when motivated. However, there could be limitations with this deduction and a need to interpret it with caution as other things can influence this outcome especially when applied to a wider population of CM students. There could be some institutional motivational approaches to help students prepare and be encouraged to take and pass the exam which can vary across programs and universities. Some CM programs may be providing revision incentives to students while others leave students to study alone. Others may be paying the exam fee for students as incentive to excel or students pay and get reimbursed by university/program if they pass the exam, etc. These may have differing levels of motivation that affect passing rates whether with high or low GPAs.

In conclusion, this research showed that the performance of students in undergraduate CM curriculum has a positive relationship with the AC exam scores and so this could be a decent indicator of their abilities to pass AC exam before getting in the construction industry. The correlations semesterwise and for the whole sample were statistically significant to warrant a conclusion of reliable relationship across the variables examined. The outcome of this study aligns with Ford et al. (2012) where this current study has correlation of 0.436 between AC and GPA scores while Ford et al. (2012) had 0.60 between AC and SAT scores. Thus, the hypothesis of the existence of positive correlation between AC exams scores and UGPAs was supported. Noteworthy, it would be logical to argue that other factors such as emotional stability and motivation to take the exam could also impact success, and so this positive correlation should not be construed to mean causation, and generalizability of the outcome to the whole CM students' population should therefore be done with caution. This research contributes to the correlation studies and its outcome could provide useful information to CM students wishing to pursue AC certifications. Further research may involve predictive research on the subject.

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