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# Online Capstone Projects Leveraging Technology for Low Budget Community Establishments

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# Abstract

Two leading paradigm shifts are taking place in teaching-learning today that are expected to have major and long-lasting impacts. The first one is the current environment and restrictions due to COVID-19 has driven academia to evaluate alternatives to traditional education. The leading option being deliberated and studied is a robust and effective online platform with virtual classrooms using modern and powerful Learning Management Systems. The second paradigm shift is due to the rapid advances in technology and related services that are redefining the way business operates. This is instrumental in the effort to understand how these technical developments are reprioritizing functions that are affecting the company financial bottom line. These changes, in turn, are requiring academia to adjust and update their curriculums to meet the new market needs. In academic institutions, a capstone project is a powerful concluding exercise as the last course(s) of the program that effectively strengthens the student proficiencies to apply the knowledge they have learnt in the program to a real-world situation. Every academic program arranges and builds the requirements of its capstone project with its own program specific targets. This research evaluates online capstone projects in the programs and focusses on ways to benefit the community low-budget organizations with these projects using modern stateof-the-art technologies and available online resources. These projects are undertaken with minimal or no budget and with an aggressive schedule – exactly what these establishments need. This study begins with an examination of the traditional practices followed for a capstone project and establishes ways it strengthens the goals of the curriculum identified by the learning outcomes of a program. The analysis further recommends measures and methods to arrange the customer project to try and guarantee meaningful and market relevant learning experience for the leaners. This is expected to be beneficial in their professional careers later. Current conventional practices are assessed and those that yield the target results in a time-restricted format are noted. The results suggest that approaching and creating projects using these best-practices guidelines is a practical way of helping students gain significant hands-on experience with emerging technologies and, at the same time, implementing a valuable project for the benefit of the lowbudget establishments in the community.

**Keywords:** Agile pedagogy, AWS cloud, community service, cPanel, hash algorithm, infrastructure, LMS.

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### Introduction and background

Structuring and customizing capstone projects for low-budget start-up organizations with an aggressive schedule is challenging but has substantial benefits in the local community and augments the academic objective of providing beneficial community service. Working with these projects add to the real-world experiences for students and opens up opportunities for them to experiment with current and emerging technologies, creating a favorable situation where both the low-budget community organizations and the learners are winners. The results support the notion that this is a sustainable method to augment the objectives of providing beneficial service to the community, improving the learner experience, provide them the opportunity to work with emerging technologies, and meeting the stipulated learning outcomes of the academic institution (Sinha, Dey, Amin, 2021).

Computer Science, Information Technology Management (ITM), Information Systems, and Engineering curriculums at National University (NU), and in most academic institutions, integrate rudiments and fundamentals of programming, database, networks, security, Information Technology (IT) infrastructures, and understanding of the latest technologies to address realworld problems (National University General Catalog V83, July 2020). Students work on capstone projects that incorporate concepts from courses taught throughout the program. The learning experience is designed to expand their capability to address problems and opportunities by using knowledge assimilation from multiple courses in the program. At NU, Department of Engineering and Computing (DOEC), these curriculums combine communication protocols, problem solving abilities, simulation techniques, and mathematical essentials, with practical considerations required to address market and social opportunities and challenges (National University General Catalog V83, July 2020; Jenefsky, et.al., 2009). These curriculums are designed for professionals to promote the understanding of the multidimensional space of their respective specializations and use them to solve multidisciplinary problems. These programs combine theory, applications, practical projects, and research to offer a complete view of the traditional and emerging technical practices. They also require students to design and implement a three-month duration project in their final year (Campbell and Lambright). Structuring these projects in an accelerated and time-constrained programs, requires systematic formulating and development with an agile project management paradigm. Curriculums are tailored for technical experienced professionals to further their careers and proficiencies in their fields and to apply learned skills in their everyday work. These programs emphasize multidisciplinary familiarity, introduced to the learners with a combination of theory, research, practical projects, and presentations, highlighting and encouraging critical thinking and self-directed research (Sinha et.al, 2015; Sinha et.al., 2014). The capstone project at the end of the program is a summary experience, to bring all aspects of the program together and improve the students' ability to apply the multidisciplinary skills to real challenges (Campbell and Lambright). These projects are completed and presented to a group of evaluators for review and assessment after the threemonth period. This study validates the concept that structuring these capstone projects by following some guidelines is a measurable approach to verify a successful completion that benefits the low-budget community units (Sinha et.al, 2015; Sinha et.al., 2014). Additionally, by

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using the agile methodology for the project management, it improves the continuous communications with the sponsor during the lifespan of the project.

Campbell, Garris, and Jennings, in their respective research, suggests that a practicum or capstone project is an invaluable one-off end-of-program experience (Sinha et.al, 2015; Sinha et.al., 2014) that develops and encourages students' capacity to integrate multidisciplinary knowledge and skills they have learned (Campbell and Lambright; Garris, et.al., 2008; Jennings, 2003). Programs in different fields and curriculums structure their capstone projects with program specific objectives (Jennings, 2003). A critical evaluation of one community project in the BSITM academic program for a low-budget organization is presented which also happens to be a non-profit establishment, in the technology space. Traditional approaches to suggestions and recommendations for crafting effective capstone projects (Allard and Straussman, 2003; McGraw and Weschler, 1999) and promoting learner reflection and critical thinking have drawn considerable attention (Bushouse, 2005; Bushouse and Morrison, 2001). The traditional methods mostly focus on the aspects of students learning and experience of project-based activities, whereas this research takes it to the next step - how to make it instrumental in providing significant benefit to the sponsoring organizations who actively participate with students in the projects (Schachter and Schwartz, 2009). These establishments become involved in project activities when they find the projects serve their business interests (Bassinger and Bartholomew, 2006), and this is a source of free technical help that facilitates project completion in situations where technical expertise is costly (Bushouse, 2005; Bassinger and Bartholomew, 2006). In addition, some of the community organizations are motivated to make contributions to student learning (Bassinger and Bartholomew, 2006; Gelmon et. al., 1988; Sandy and Holland, 2006) and to cultivate good citizenship (Bassinger and Bartholomew, 2006). Students experience project-based learning with real-world environmental, cultural, economic, and social constraints, and enhance their understanding of racial, ethnic, and other differences and similarities in society (Worrall, 2007).

This investigation confirms that organizing and tailoring capstone projects for budgetconstrained community establishments is both a sustainable and realistic way to enrich the ability of providing beneficial community service, enhancing learning experience, and simultaneously, achieve the expected learning outcomes of the academic program. Specifically, this paper is a study of one capstone project, as an example, in the BSITM academic program at NU: 'Community of Gifts (CoG)' application for 'Written for Christ' nonprofit organization. It establishes how the projects fulfill the BSITM Program Learning Outcomes (PLOs) and, using the latest technology and advances in the technical space, provide useful community service – especially organizations that need to get the project completed quickly with little or no expenses.

# Low-Budget Capstone Projects

The BSITM capstone project is a three consecutive course sequence spanning three consecutive months that uses multidisciplinary theories, applications, and technical tools that are used in the curriculum (National University General Catalog V83, July 2020). The deliverable is a functioning implemented project and a working prototype of a real-world opportunity that meets

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the specifications of a collaborating cooperating sponsor. Students complete their projects and present their completed work to a panel of judges who are professionals in their subject. Grading is H (Honors), S (Satisfactory), or U (Unsatisfactory) only (National University General Catalog V83, July 2020). Students use the agile development technique for planning a well-designed and optimized implementation. Due to the schedule and the limited budget, there is little room for redesign and rework. A team typically consists of a group of learners who work with the faculty member instructor. Also, during the project definition there usually is a sponsor who has agreed to be the customer and who actively participates in the development life cycle. At the end of the project duration, a working product (prototype or a detailed proof-of-concept) is presented to a panel of judges, and a formal report is created. During the project lifespan, students go through the following four phases (Sinha et.al, 2015; Sinha et.al., 2014):

- A. *Phase 1 Definition:* The student team presents the needs of a potential client and an outline of the possible project in the first week. Classmates and the instructor ask questions and offer criticisms related to the clarifications of requirements and specifically coverage of different areas of the program disciplines. All possible technical challenges and high-risk areas are discussed to confirm that the scope of the undertaking is reasonable that is deliverable in a short three-month duration. A clear project proposal is the conclusion of this phase.
- B. *Phase 2 Iterative Functional Specification:* The project scope is iteratively refined by frequent consultation with the sponsor to ensure a reasonable and doable project. As the outcome of this stage, the team produces the abstract, introduction, literature review, and a list of citations and references used so far. In consultations with the sponsor, a list of the project objectives and a list of deliverables are generated. The first month must also include a working proof-of-concept prototype of the planned final product, particularly to verify and practice the technical high-risk items, such as new applications, tools, or emerging concepts that are required by the project.
- C. *Phase 3 Product Implementation:* The second and the third month are used to implement a functioning product as planned and defined by the project. This implementation is tested against all the features and requirements of the client and to confirm that all the functional specification are met. Literature review and research on the topic continues, the reference list is increased, and citations are added as appropriate. A demonstrable prototype implementation that meets all requirements is delivered.
- D. Phase 4 Project Report and Presentation: This project report is the final deliverable. If needed, a user manual is also included separately or as part of the report. This report and the user manual are produced for submission and a presentation is created that includes a demonstration of the working product. Quite often, these reports are the basis for academic publications. The presentations may be in-person or recorded video (PowerPoint with VoiceOver). Some students prefer to post them on www.youtube.com for easy distribution and access.

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Analysis and Validation Using an Illustrative Example (Luna et. al., 2019; Hanson et. al., 2020)

Often times students are, directly or indirectly, encouraged to look for a large corporation in Corporate America. This is not always a good fit for the graduating students. Sometimes the local community would benefit more if these future employees made a different selection in jobs. The Capstone Project could be diverse in employment sector and opportunities, just as employment opportunities are. There are about 10% of the jobs in America which come from nonprofit sector and 16% of jobs come from the government sector. When we only look at forprofit companies, we miss about 26% of the available jobs. The nonprofits have low technology and high technology employment opportunities, which often include websites, databases, servers, and applications (Candid Learning; Hall and Greene, 2013). In this example, we have selected what a group of students did for a startup low-budget nonprofit. The Capstone Project analyzed in this study was designed and implemented as a 'Community of Gifts (CoG)' application for 'Written for Christ' nonprofit organization. This was also a way to create an opportunity for collaboration between the university and the community (Bushouse, 2005). This partnership for the low-budget organization consisted of upgraded design of their existing infrastructure, migrating from the legacy network to a stable and robust upgrade, utilizing recent advances in technologies. This virtual infrastructure was designed using the cloud-based Amazon Web Services (AWS).

The CoG was a software/database tool for churches to help ensure those in need within the church and possibly in the community. These needs could include groups of skills such as: ride share, home construction/repairs, landscaping, homecare, financial advice, or technology training. The requestors and workers need to be preapproved by the church as level two security (Friends/Members of the church). Those within the church register their names, address, skills, and the number of hours they are willing to volunteer, into the database. When there is a need of a member of the church, they make their request to the software to find those with the skills. The software then searches the database to find someone who best meets the precedence rules. Once the database finds a prospective worker, the software sends out an email to the worker. This step is repeated until a worker is found. Once the task is completed, the worker, requestor, and church administration update the software. The focus of this project by the team was to extend and enhance this with new features. This site was hosted on AWS using a Linux based virtual server with a SQL database. The completed process also included using PHP programming, GitHub version control, MySQL as a database backend, Amazon EC2 Web Services as cloud-based server, Amazon Relational Database, Adobe Dreamweaver as a PHP testing platform, and XAMPP. The team, KLICK Media, worked with the 501(c)3 nonprofit Written for Christ to create the product Community of Gifts (CoG).

CoG Technologies presents Non-Profit E-Service (NPE). NPE is a community website that provides members of a church the opportunity to assist each other with services and assistance through a workflow process. This Information Technology project utilized AWS infrastructure utilizing Amazon Linux AMI, cPanel, and Web Host Management (WHM), using CENTOS 7.7 for central management, and MySQL database in the backend, to assist in accomplishing the

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successful implementation of the website. CoG Technologies successfully developed and implemented the MySQL database (Coronel and Morris, 2019) by developing a user interface for entering expenses, creating a report of expenses, and generating reports for the Deacons for project closure. Using Git, a version control application used on AWS, members of CoG were able to write PHP and HTML code to update the website and develop drivers for the database (Coronel and Morris, 2019). Additionally, through research and collaboration with the Sponsor, CoG Technologies discovered and implemented Simple Mail Transfer Protocol (SMTP) interface. CoG's implementation of SMTP using Amazon Simple Email Service (SES) creates email notifications for all of the actors involved sending an email to their personal email address that is stored in the database. These enhancements allow administrators to run queries to find out what jobs are open, work in-progress, closed, or requires expense resolution.

The following was the list of the main (in addition to report, user manual, etc.) deliverables for the project.

- 1. Method to populate and update the current database
- 2. Implementing the AWS cloud infrastructure and services
- 3. Create a login system with PHP and MySQL database
- 4. Implementing SSL certificates
- 5. Content Integration/Upgrade
- 6. Launching the site

No specialized hardware was required for the implementation of the website. The website was hosted on AWS which provided all necessary virtual hardware to run the site and server to store the database. A Linux based virtual server was created in AWS. This is called the Amazon's Elastic Compute Cloud (EC2) instance. This virtual server executed a cPanel Graphic User Interface program that is used for web hosting. The design of the web site was completed with Adobe Dreamweaver. There are many programs that could be selected for the web design, and this program was selected due to the familiarity to the group and ease of use. In addition to Dreamweaver, the program Xampp was used for the creation and testing of a database for the site. These programs did not require any specialized hardware to operate and could be used with a PC meeting the minimum requirements.

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**Figure 1. User System Interface** 

The project and the final product for this church was hosted on AWS, where the Domain Registration and the Domain Naming Service was routed through Amazon Route 53. These services allow the webmaster to add, delete, and update any DNS records in their hosted zones. This service allowed the registered domain name to translate to the public IP address assigned to the EC2 Instance. This service additionally allowed the webmaster to direct traffic to all sub-domains created in cPanel. Amazon Route 53 also allowed the webmaster to redirect traffic to an external site. This feature is extremely useful during maintenance or possible modification of the website. This process and the determined effort by the team was instrumental in building a successful solution using available resources, an important consideration for the low-budget non-profit sponsor. The user interface to the system at a high level and the actors using the final product is shown in Figure 1.

Figure 2 illustrates the network configuration and the infrastructure entities with a high-level abstraction. Internet service was provided with a dynamic service communication line coming into the system. The Netgear wireless access point, which offers many advanced features, was being underutilized, and not being used to its full capacity. The server was functioning as the Primary Domain Controller, but this was an old device due to the dated hardware specifications. The existing system was operating with an obsolete and unsupported version of the Window Server Operating System.

The database was hosted on AWS and populated by church members and administrators. There were different levels for volunteers and also for requestors, and populating this database required

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review by administrators. A process of inputting the data was followed to ensure data integrity. The model from (Coronel and Morris, 2019) was used including the process which an administrative role needs to follow to validate incoming data requests. Each event must be analyzed by the lead admin in order to input the information into the database. The program Xampp was used for the creation and testing of the database for the site. This was paired with MySQL. The MySQL, which is executed on phpMyAdmin, is a feature available on the AWS cPanel Web Hosting Manager. Xampp allowed sample testing paired with adobe Dreamweaver.



Figure 2. High Level System Architecture

The goal of the project website was to ensure overall secure to the general public and to possible hackers. A Hash Algorithm was deployed to protect the site. MD5 Message Digest checksums was used. This is generally used to validate data integrity when digital files are stored and/or transferred. MD5 checksums maintains a solid base of data for incoming requests from potential users. A salted hash algorithm also protects the database from being tampered with by hackers. The project portal has different rights for higher level members. The members use a username and password to gain access to their profile, which contains data that may be sensitive to the user. Amazon EC2 is the AWS Virtual server that executes the user applications in the cloud, and that is the hosting site this implementation rans on.

Elastic Load Balancing, a feature on AWS, distributes incoming application and/or network traffic across multiple targets, such as Amazon EC2 instances, containers, and IP addresses, in multiple Availability Zones. This load balancer was configured to route traffic to the EC2 instances. Elastic Load Balancing scales the load balancer as traffic to the application escalates or changes over time and can scale to the vast majority of workloads automatically.

The landing page and member login page are web-based application, accessed via internet. The Graphical User Interface (GUI) and the GUI transitions were designed to have short load times between links and customer requests.

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The testing phase was a challenge due to time constraints, but successful. This consisted of setting up the website and inputting sample test names and members and conducting dry runs of members applying for a position within Community of Gifts. Bugs were reported to the Program Manager (PM) and resolved (A Guide to Escalation in Project Management, 2018).

# Analysis and Validation of the Capstone Project

The NU BSITM curriculum is created with UpToDate Information Technologies (IT) concepts and IT Management (ITM) practices. This encourages learners to appreciate requirement evaluation, creative problem-solving methods, innovations in IT design, and latest ITM techniques. As retrieved from (National University General Catalog V83, July 2020) and (Sinha et.al, 2015; Sinha et.al., 2014), the requirements and objectives of the program are reflected in the seven PLOs as shown in the "Program Learning Outcome" column in Figure 3.

In this curriculum, students are exposed to theories, and rigorous practical activities in the ITM space with monthly four-weeks long courses. As the concluding three courses of the program, all students are expected to undertake a project that constitutes as the capstone project. This gives them the necessary experience to apply technical platforms to solve problems and address opportunities with various new and innovative technologies and platforms (Sinha, Dey, and Amin, 2021). Learning Outcomes are covered at the end of the three consecutive project classes that span three months. Teamwork is strongly encouraged, and students work in groups to gain valuable collaboration experience essential in the industry environments. In the first month, students form groups of 2 to 4 students per group, make project management (A Guide to Escalation in Project Management, 2018) assignments, select research topics, conduct literature reviews, address process challenges, and develop a project plan to achieve a workable activity strategy for the next two months. In the second and the third month these teams 1) perform the necessary tests/experiments, 2) collect data, 3) create a prototype, 4) prepare the project report, 5) create and deliver a formal presentation, and 6) demonstrate a prototype (working proof-ofconcept) of the project implementation (Sinha, Dey, and Amin, 2021; Sinha et.al, 2015; Sinha et.al., 2014). All capstone projects are assessed and graded by a panel of judges, consisting of members from academia and professionals from the industry, using an "Assessment of Program Learning Outcomes" template containing the assessment criteria and metrics - as shown in Figure 3.

In this example BSITM project, a detailed literature review was performed by the team in order to identify similar or near similar products available in the market, thus enabling to differentiate this product and compare-contrast with these other close products. The judges, after reviewing the submitted report, participating interactively with the students during the project presentations, and scoring the project using the assessment rubrics, submitted their individual evaluations to the BSITM Academic Program Director (APD). Grades were assigned for the project as a group project. Each team member in this particular project received the same grade.

The project was evaluated based on PLOs of the program. This is illustrated in the Figure 3. The judges determined that the students exceeded in their accomplishments and were successful in acquiring the appropriate BSITM knowledge and practical skills in this field. The possible grades

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assigned for capstone projects in the BSITM program are H – Honors, signifies outstanding achievement, S – Satisfactory, signifies acceptable achievement, and U – Unsatisfactory, signifies unacceptable achievement (National University General Catalog V83, July 2020). No grade points are assigned for this capstone projects. In this project, the students received the H grade.

NATIONAL UNIVERSITY Department of Engineering and Computing, College of Professional Studies			
Assessment of Program Learning Outcomes (PLOs) Bachelor of Science in Information Technology Management (BSITM) Project: 'Community of Gifts' for 'Written for Christ'			
PLO	Program Learning Outcomes	Assessment Criteria and Measurable Outcomes	Team Grade [25 Max]
1	Demonstrate an ability to set up and integrate local and remote server and workstation computers with proper user authentication to preserve user privacy and confidentiality.	Project Report Project Demonstration Project Presentation	21 23 22
2	Demonstrate the ability to plan an integrated system that involves computer applications to satisfy specific business processes.	Project Report Prototype Demonstration Project Presentation	22 23 20
3	Demonstrate, manage, and administer a LAN and wireless networking environment.	Project Report Project Demonstration Project Presentation	21 22 23
4	Design, develop, administer, and support a robust relational database management system.	Project Report Project Demonstration Project Presentation	23 20 23
5	Apply concepts of best practices in information technology management and security to enterprise processes.	Project Report Project Demonstration Project Presentation	21 22 24
6	Describe the ethical challenges that confront an IT professional	Project Report Project Demonstration Project Presentation	23 21 24
7	Demonstrate written and oral communication skills in collaborative environments by participating on teams that address solutions for IT management	Project Report Project Demonstration Project Presentation	23 22 22
	challenges.		

# Figure 3: Capstone Project Grading by PLOs

# **Guidelines for Undertaking Low-budget Projects**

This section contains the recommended best practices for making sure of the successful completion of a low-budget IT project for a community organization or a non-profit establishment, on a short aggressive time duration. These recommendations support the

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hypothesis that defining, designing, and implementing capstone projects leveraging new available technologies, and following the guidelines offered in this paper, is a feasible and effective way of improving student experience and student learning, accomplishing the specified learning outcomes of the educational curriculum, and a timely completion of the capstone project for low-budget community establishments (Sinha, et. al., 2015). Guidelines for undertaking these community capstone projects include:

- A. *Listen to Client Needs:* This is an important practice to get the project defined properly and efficiently. The team needs to design the project based on the requirements and priorities of the client, not on any personal preferences or bias towards any cool technology. This is usually an iterative process as the client is also not very clear initially about the feasibility and practicality of all features. The client needs to be intimately involved in the project definition process at this initial stage so that the possibility of rework and redesigns are minimized.
- B. *Project Must Meet all PLOs:* Instructors must ensure that all projects address all the PLOs specified by the program. The mission of the BSITM program at NU is reflected in the PLOs as explained in the previous section and also in (National University General Catalog V83, July 2020; Sinha et. al., 2015). These Learning Outcomes are accomplished at the end of the three-month capstone project, covering areas of client-server, cyber security, IT management, networking, RDBMS, and available tools/platforms. It is necessary that students make sure that all expected program areas are addressed in the project. This needs to be done during the definition phase, so that the possibility of rework is minimized.
- C. Community Sponsored Undertaking: The capstone projects for low-budget establishments should be useful and beneficial to the community. To realize this opportunity, it is suggested that the project be sponsored by a community representative. Business units are usually, and justifiably, interested in such collaborative efforts from their financial bottom-line perspectives (McGraw and Weschler, 1999), as a source of low-cost technical resource, that helps them to complete a quick implementation of a proof-of-concept product in an aggressive timeframe. This might not be otherwise possible (Bushouse and Morrison, 2001; Bassinger and Bartholomew, 2006). This also provides the establishment with an opportunity to work with the students and, in many cases, hire good candidates later. From the student perspective, they get involved in real projects, understand real-world parameters that need to be considered, and the priorities of different players. These are invariably interdisciplinary efforts, involving multiple and diverse stakeholders, and the system being designed must address their distinct, and sometimes diverse requirements. This also enables the students to appreciate a valuable lesson that a project involves many users (shareholders, administration, customer, etc.) and all come to the table with their specific perspectives and objectives.
- D. Assessment Criterions must be Transparent: At NU, all technical capstone projects are reviewed and evaluated by a judging panel consisting of members from the academia and professionals from the industry. They are all experienced and knowledgeable in that specific and related space. An assessment template, shown in Figure 3, is used by the

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BSITM program which contains all the assessment metrics. It is essential that the students are familiar with this evaluation rubric and understand the breakdown of each item.

- E. Team Owns the Project: The experience of the authors with student projects always astonishes them by what the students are capable of achieving on their own when they take ownership of the effort. This particular observation cannot be overemphasized. Students must be convinced that this is their special project. They must own it, be excited about the opportunity, and be proud of the undertaking. In the initial stages a team is understandably hesitant to take charge. In a typical industry establishment, the concept of personal accountability is critical, and is usually the most overlooked characteristics of an efficient work environment. Similarly, during these projects with students, the instructor, working with the team, must make sure that the members are invested and in-sync with the team goals. Each student's views and opinions on important decisions must be encouraged. Every member must have a voice so that he is convinced of the importance of his contributions that leads to the success of the team. Opinion may be rejected on occasions, but every member must be convinced that he is being heard. This goes a long way toward creating trust, relationships, collaboration, and improved engagement in the project. Additionally, some students often hesitate in making decisions and in taking ownership of a project because they are not sure if they are expected to. They wait to be told what to do or they are afraid of making a particular decision with which others may not agree. It is essential to delegate responsibility and ownership effectively and communicating clearly where the decision-making must happen. Allowing the students to make those decisions goes a long way in ensuring the team takes ownership of the project, thus ensuring a successful and timely completion.
- F. *Project Feasibility Evaluation:* Feasibility analysis is critical for defining the scope, boundaries, and functions of the project. This must be worked out in three areas: Operational Feasibility, Technical Feasibility, and Schedule Feasibility. The team must be clear about how the proposed project meets the identified opportunities, the operational outcomes, and if the technical challenges are understood. Plans also must be in place to ensure that the requirements of Schedule Feasibility are also studied and incorporated in the plan. This analysis must be done and completed during the early stages of the design phase. This is an essential part of project definition that needs to be completed up-front before starting on the details. The team must estimate the time each part of the project is expected to take to complete. Given the team's technical expertise, the students must ensure that the project deadlines are realistic.
- G. *Literature Review:* A literature review defines the scope and puts the project in context. Understanding past work and research available in the literature is important and helpful in putting the project in perspective. This step clarifies what is innovative about this project, how this project may be differentiated from others and, most important, the reason for using this product as opposed to picking a nearly similar product from the market. This effort must be documented with necessary references and citations.

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- H. *Early Prototype New Technologies and High-Risk Items:* A working prototype is a demonstrable skeleton version of the final edition consisting of a few critical modules created and put together in an agile manner. This offers the sponsor and the target audience with an early view into some of the functionality of the product. This also permits the team to confirm the feasibility of the high-risk key elements of the project. Encourage early implementation of this model to give them confidence regarding the feasibility of the project completion successfully on time.
- I. Monitor Project Plan: The significance of a meticulous plan cannot be overemphasized. Any available software product may be used to create the schedule, e.g., MS Project, MS Excel, etc. This helps the team to work through each section of the project definition, resources, practicality, and schedule. Responsibilities are decided and documented. Sharing responsibilities for the common good brings the team together. As is often the case encountering unforeseen issues and delays are always possible, hence must be expected and planned for. Working with new technologies increases these possibilities, and these adjustments and possibilities must be integrated into the schedule. Informal team meetings on a weekly basis, or more frequently as required, is strongly advised, with compulsory participation of all team members and, as needed, of the instructor and the mentor (Sinha et. al., 2015; Sinha et. al. 2014).

# **Concluding Remarks**

The two significant paradigm shifts in teaching and learning today are 1) the move towards student learning in virtual classrooms using contemporary powerful Learning Management System (LMS) platforms, and 2) the ever changing market demands due to the rapid advances in technology and technical related that are redefining the way business operates. These technical advances are reprioritizing functions that are affecting the company financial end results. This, in turn, is necessitating academia to adjust and update their curriculums to meet the new market needs. In this research, technical capstone projects, designed and implemented for low-budget businesses, were examined, and evaluated to determine the validity of the notion that useful community projects can be undertaken, leveraging advances in technology, with very lowbudgets and completed with an aggressive schedule. Projects, using new emerging technologies were defined, architected, implemented, and tested by student teams under the supervision of faculty members, with the goal of creating a significant value-add for the community organizations, and also meeting the program academic PLOs. This study examines the organizing and handling of a student project and verifies how it strengthens and supports the academic intentions of this prospectus and the specific intended outcomes. These results validate the hypothesis that the capstone project, using advances in technology, is a realistic and reasonable way of providing beneficial service to the society, a practical way to enhance student engagement, and meet the learning objectives of the program.

The results of this project were encouraging. Migrating to AWS was a milestone, and the conclusion was that Cloud Based Technology is efficient and cost effective while setting up the infrastructure and security parameters in a virtual platform. The project management (A Guide to Escalation in Project Management, 2018) lessons learned were beneficial to the students. Web-

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based tools, such as Zoom and E-Mail, allow for real-time group communication to implement changes and adjust to plans. Teamwork allows the discovery of a user-friendly GUI in the form of cPanel Web Hosting Manager on AWS to propel these types of technology based low-budget projects to the next level. With the security measures in place, and the database up and running, this initial project is proof that these features and capabilities are readily available for any church to host its volunteer services on. Other projects with different emerging technologies, e.g., AI, Blockchain, Data Analytics, IOT, social media, etc., have been undertaken and are either complete or in-progress. All confirm, with promising results, significant benefits to students learning and to the low-budget establishments in the community.

The example project analyzed in this paper is capable of being deployed on a larger scale. It may provide a digitized volunteer service for many churches in America. There are thousands of churches across the country which could benefit from an organized database, some of the largest crowds drawing upwards of 40,000 attendees. A cloud-based service such as with AWS would be the most cost-beneficial to handle large Relational Database Management Systems (RDBMS). These larger-scale RDBMSs could potentially be handled in the same format as the Community of Gifts portal for this project. The biggest constraints will be the size of the church, and the amount if IT manpower required to handle a church with tens of thousands of members. This AWS RDBMS was built in roughly three months, so with increased manpower and a business marketing budget, this effort can scale significantly.

Changes are a continuous process in academia. Given the opportunities made possible by new technologies, this research needs to continue and other related areas that are touched or are contributing to the advancements need to be analyzed and evaluated. This is a win-win situation and an opportunity to help the community, and also the students in academic programs. Following are some of the areas that are recommended for further continuing studies:

- 1. The method of understanding and capturing the requirements of the low-budget organizations in the community needs to be improved and eventually automated with available advances in technologies. The possibility of creating an online platform where these organizations can enter their requests for possible capstone projects, has big potential (Sinha, et. al., 2015). These requirements need to be evaluated to ascertain if such an undertaking is realistic in this format, beneficial to the program, meets the academic relevance, and whether the establishment has the appropriate resources with available bandwidth to work with students in these collaborative projects. With this application, student teams will be able to identify possible projects, discuss the details with the sponsor, and request assignment to a specific project. These requests will be evaluated by faculty members, and the appropriate project can then be assigned.
- 2. Infrastructure virtualization, use of Big Data, AI, Blockchain technology, Data Analytics, social media, etc., are a few of the emerging technologies that have wonderful potential to be a value-add in these emerging teaching-learning spaces. These need to be analyzed, and possibilities need to be evaluated that may be beneficial to both the students and the community establishments.

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- 3. Role of an instructor is getting redefined with this emerging teaching-learning model shift. This new role needs to be defined and this effort to understand how the instructor can make important contributions in this role needs to continue. It is expected that this effort will include evaluating available and emerging Learning Management Systems and upcoming advances in technical progress for more robust content creation and efficient distribution. This is expected to speed up accomplishment of project deliverables with enhanced quality and improved ease of use (Sinha, et. al., 2015).
- 4. This concept of capstone projects for low-budget community establishments can be extended to projects that can be undertaken in one or a string of program courses. Specific focused projects on particular areas, e.g., RDBMS, or Networking, etc., can be completed during course (s) on that subject. These could be an effective learning tool for the students and also valuable to the community.

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