

Atmega Automation - Restaurant

Final Project Paper

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Abstract

This project has been initiated as part of the course MIS 576 Project Management. Through this paper, we are documenting the project from the project management aspect of a robotics company which is proposing to automate the conventional wait staff at the hotels and restaurant. This document includes a complete project proposal proposed by Atmega Automation including comprehensive and realistic assessment, research and development which was performed to accomplish the desired scope of the project. Nowadays, we are aware that the robotics industry is growing in almost every sector, from basic robotic mechanical arms in manufacturing industries to home automation, self-drive cars, facial recognition, etc. Hence, through this project, we are trying to extend the robotics industry to the hospitality and food industry by introducing the humanoid robots to accomplish a basic goal of automating the wait staff at the restaurants. Through this, we are going to introduce robots to the emerging and potential market areas across the world. We have implemented the project management concepts acquired in this course to make this project successful. During the initial phase, we have assessed the actual goal and have created a plan considering all the possible risks. Further, we have determined how to manage the project as per the plan. Also, we have identified the cost benefits associated with this automation. Hence, through this paper, we are delivering a plan for controlling the project within the specified time frame and also at minimum cost with the desired result to accomplish the goal of automating the wait staff for the existing restaurant.

Keywords: Project management, Robotics, Mechanical arms, Self-drive Cars, Humanoid Robots, Facial Recognition, Automation.

Introduction

The restaurant automation is going to merge the best from the robotics industry, this will be served by Atmega Automation with the hospitality and food industry. This project is going to replace the actual human staff at the restaurants with the well-trained humanoid robots. The primary aim is to increase the profits by increasing the customer base by introducing this innovative idea.

As a starter step, the restaurant automation is going to follow the subsequent working process. This process outlines the basic scope and requirement for this project. See Figure 1.

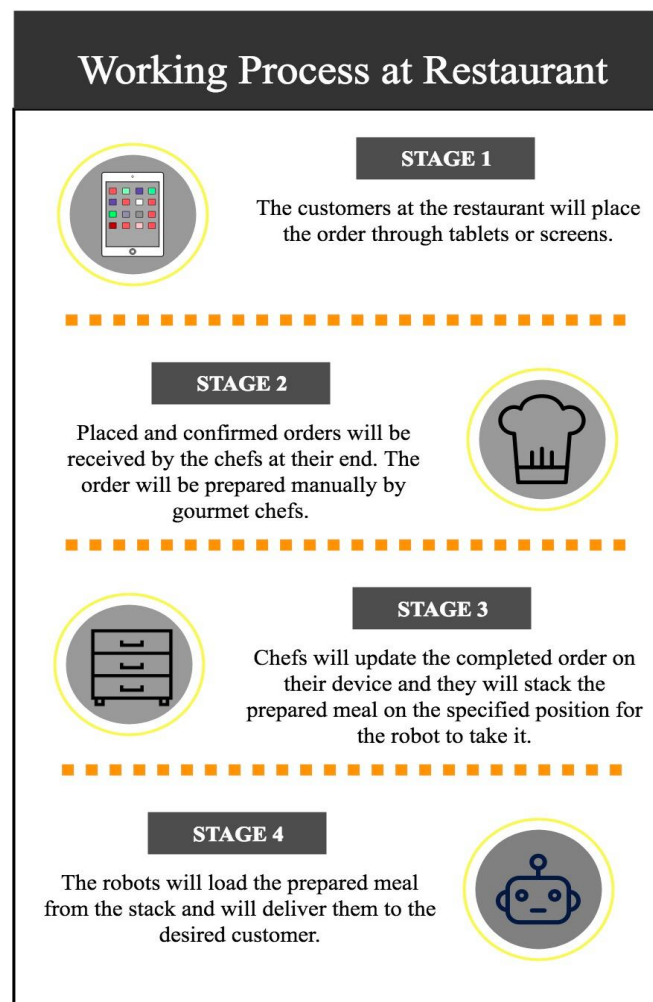


Figure 1: The Proposed Working Process

The current process involves human wait staff who take the order, either using pen or paper or the handheld electronic device and pass the order to the kitchen, i.e., to the chefs. The chefs prepare the meal and wait staff delivers the meal to the customer. In this project, we are going to automate this manual process completely. The proposed process is to take the order from the customers digitally, either through the attached electronic device on the tables or through robots, send them electronically to the kitchen and getting them delivered to the customer through human-like robots.

The humanoid robots will be programmed initially to navigate around the restaurants as per the floor plan or layout, taking food and drinks or serve the orders to the customer and take back the dirty dishes back to the kitchen. After the initial installation, the functionalities will be extended to facial recognition to gather insights about the customer satisfaction based on their facial expressions, audio assistant to answer the questions asked about the food and other menu items.

Statement of Work

Project Description

To automate a restaurant belonging to a five-star hotel by installing robot wait staff and to customize the interiors within the duration of 18 months and under the budget of \$3,400,000.

Project Requirements

The high-level requirements associated with this project can be categorized into three sections, infrastructural, and functional requirements associated with robots and training and maintenance.

Infrastructural Requirements

- Floor plan having the details for the robot tracks, pick-up stations, dump stations, and charging stations.
- Robot themed interior, i.e., changing the visual appearance of the existing place by introducing sci-fi elements in the interior.

Robot Requirements

- The humanoid robot having the capabilities to follow the lined track, take orders from the customers, deliver the order to the customers, facial recognition capability, etc.
- The software component to run the machine and the display screen on the robot.
- 24x7 charging station.

Training and Maintenance Requirements

- Well-designed training module for the existing staff to function the restaurant using robots.
- 24x7 assistance for robots.

Project Milestones

The project consists of five milestones until the completion stage. Firstly, all the project related documentation associated with the project initiation phase will be completed. These documents include requirement elicitation and specification, case scenarios, project charter, etc. For completion of this milestone, an approval will be taken from the client for the final requirements and the charter. After the approval from the client, business licenses associated with food safety and other environmental factors will be considered. Once all the permissions are granted we can move to the next milestone.

The second milestone will be the planning and design phase. This is the most crucial phase of the project as its success relies on the prepared project plan. In this phase, we will define the project scope based on the approved requirements, development of work plan and project team, project schedule, identification of potential risks or issues associated with the project and finally coordination of the project activities. The blueprints and floor plans, software architecture and test case suites will be designed simultaneously once the project scope is defined. This milestone will begin on July 1, 2018, and ends by November 30, 2018.

The third milestone will be to develop and test the robot for the functional capabilities. Also, to develop and test the robot software for proper functioning. The estimated time frame to accomplish this milestone is 1 month.

The fourth milestone will be the actual implementation phase. This milestone has two parts, on-site customization, and installation. The on-site customization includes installing the floor layout for the robot paths, changing the interiors of the restaurant. The installation phase includes the complete assembly of the robots on site, setting up the charging station, and tracking the robot movement floor. This is the most sensitive phase in the project as the efficiency of the project depends on proper implementation. The duration of this phase will be 8 months. The estimated end time is August 1, 2018.

Finally, the last milestone will be the functional and physical testing of the robots. In total it will take around 15 months to build the restaurants with robots as staff. To keep the schedule realistic, a buffer period of three months is kept. This will ensure we have the completion of the project within the specified time with the likelihood of downtime or schedule delays due to the identified risks.

Business Case

The need for the implementation of the robots in the restaurants for the Five-star restaurants is fierce competition from their competitors in the neighborhood. Nowadays, the food service industry is growing at much faster rate due to there being a huge competition not only between the large providers but also from the small food service restaurants. In order to get an edge over the competitors everyone is starting to adopt some new strategies to get ahead of others in the market. Few are dropping the price of their food to attract more customer while others are trying to give their customers better ambience and service. But introducing a unique idea into the restaurant such as robots as staff will attract more customers to the shop. This will give the customers a unique experience which will attract customers. It is a costly solution for the above problem but once implemented this will provide a better advantage such reducing labor costs, reduce the damage due to human errors, increase the efficiency of the service, and the biggest advantage is it will give customers a different experience to try in the restaurant which indeed attract more money. By attracting more customers to the restaurants, the cost of the initial investment for introducing robots as staff will be recovered sooner. There is already few of the restaurants around the globe that are using such technology in their restaurants and earning better profits than when they were using humans instead of robots (Bridges, 2018).

Market Research

The market research is performed to ensure the success of this project. The research results show the evident facts associated with the hospitality and food industry states that they are trying to increase their customer base through varied or specialized cuisines and restaurant interiors. But it is not just limited to these, they are also using technology for the very same purpose. There are

a lot of instances such as the introduction of robots in Pizza Hut; robot prepared fast food meals; the first ever robot restaurant in India, etc., depicts that this is one of the emerging innovations in the restaurant and food sector (Bridges, 2018).

Further, we have identified the relationship among the robot waiter or waitress to people. The relationship of people with robots is key for success in this project. The market trends clearly depict people are more attracted to something which is not readily available elsewhere, in this case, wait staff as robots delivering their meal. Also, the results suggest that after initial installation it is apparent to build up the ad-hoc functionality in the future. People relationships can be developed by using the more advanced training for the reinforcement learning for the robots, i.e., designing a facial recognition system which makes the robot capable of identifying the customer experience by recording their facial expressions and modifying its behavior accordingly. As part of the future scope of this project, future robot behaviors can be enhanced based on the insights gathered from the customer's experience to improve the quality of the customer experience in the future.

The comparison of the capabilities between the robot and human wait staff is also vast. After the research the identified pros of having a robot wait staff are as follows:

- Fast in terms of processing and delivery. Hence, this speed will result in the reduction in the wait time which is occurred due to the delivery of the food to the customer.
- Accurate, they will be programmed to avoid the human errors.
- Reduction in the damages as human errors will be avoided. For instance, the physical damages such as damaged cutlery or dishes etc. which are very common with human staff will be reduced.
- Reinforcement learning to enhance customer satisfaction and experience.

- Robots can work without a break, almost continuously for the whole day.

However, the robot staff calls for the additional staff to handle and maintain the robots, which will be an addition to the existing staff.

The quality of food is not going to be affected by this automaton, hence, the restaurants can maintain their existing position in the market. However, this automation is going to make changes in the actual work process which was manual.

In conclusion, the market research has clearly suggested this automation will provide a competitive edge to the client over other restaurants. Also, with the advancement of the robotic world, business is growing at a much faster rate than it was a decade ago. With the growing food service market, especially in Asia, a continent where more than 4 billion people are served in a month, there is a huge demand for the fast delivery of food, hence, a good market area to sell innovation.

About the Organization

Atmega Automation is a company in the robotic industry which provides the automation solutions for several business sectors or industries. They are focused primarily on the humanoid robots and basic mechanical robots. Considering the automation aspect, Atmega Automation has successfully transformed the housekeeping aspect by bringing out efficient, zero assistance cleaning robots. This project is initiated to extend the reach of Atmega Automation to different domains like travel and hospitality as well as food-based industry.

System Description

Functional Description

The proposed system is going to automate the manual process of the wait staff at the restaurant. The primary vision is to install the humanoid robots by customizing the current interior of the place and planning in such a way that robots can function properly, such as, tracks on the floor and stack area for taking the dishes and dump area for used dishes. Also, we are going to build charging stations for robots and a navigation plan which can be modified according to the client requirements. Further, we are going to train the existing staff in handling the robots. The yearly maintenance of the robots will be provided by the Atmega Automation on the contract basis.

Technical Description

The proposed system has two major technical components the humanoid robots and a charging station. The humanoid robots are going to have both the hardware and the software component. In order to make the system work, the robots will have smart sensors such as proximity, motion, light, sound, temperature and several other for avoiding accidents on the site. They are also going to have facial recognition mechanism to identify the customer experience through their facial expressions. All this machinery is going to be bundled up by building the complementary software for smooth functioning. The second part is the charging station. The charging stations will be designed in such a way that the robots can be completely charged during the night time.

The complete system is depicted in the diagram below:

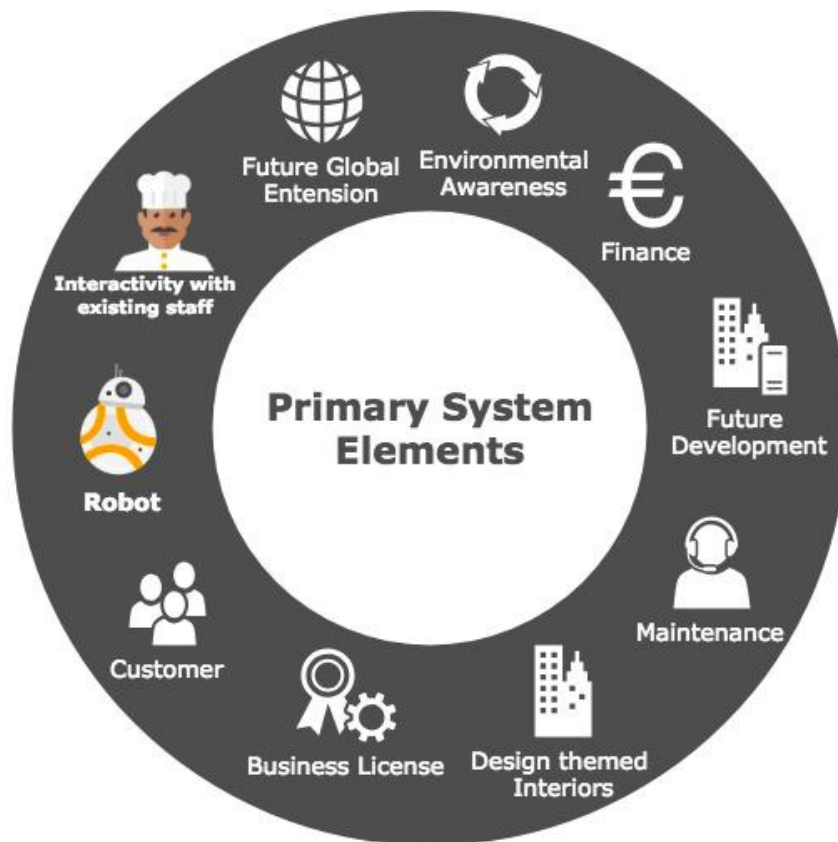


Figure 2: Major System Elements for the Project (Xie, 2016)

Feasibility Analysis

A feasibility study leads to the analysis of the prospective project. This analysis reveals the answer to the questions – Should we build this? Can we build this? Will it be accepted?

The feasibility study is performed to get a solid foundation for the project. The technology, economic and organizational feasibility analysis resulted in a green flag for this project. Through this analysis, we have identified that benefits are going to be received. Also, we have determined the estimated total costs associated with the project. There are three main feasibility analyses for the project:

Technical feasibility

Technical feasibility analysis has given us the idea about whether we can build the system or not. During the analysis, we have identified the associated risks and have analyzed whether they can be rectified or not. Firstly, considering the client's unfamiliarity with the proposed system, we have decided to come up with the proper training and maintenance. For both the client and the service provider, in order to get the competitive edge over others, it is important to extend the reach of the industry. For the restaurant to collaborate with fast-growing robotics industry to increase their overall sales, efficiency, and effectiveness.

Economic Feasibility

Economic feasibility analysis delivered us the idea about estimated investment, i.e., the cost associated with the development, operations, and maintenance. Also, the benefits or return on investments is identified by associating a value with all the tangible and intangible benefits.

A Return on Investment of 23.68% and break-even point of 2.16 years gave us a green signal to proceed with this innovation.

Year/ Distribution		2021	2022	2023	Total
Benefits					
Increased Orders		150000	165000	181500	
Reduced Labour costs		60000	60000	60000	
Reduced damage due to human errors		30000	30000	30000	
Total Benefits		240000	255000	271500	766500
Present Value of total benefits		230769.2308	245192.3077	261057.6923	737019.2308
Development Cost					
Personnel costs	110000	0	0	0	
Hardware	160000	0	0	0	
Software	70000	0	0	0	
Total Development costs	340000	0	0	0	340000
Operating costs					
Personnel Costs		30000	31200	32448	
Hardware		40000	42000	44100	
Maintenance Costs		20000	20000	20000	
Total operational cost		90000	93200	96548	
Total costs	340000	90000	93200	96548	619748
Total benefits-Total costs	-340000	150000	161800	174952	146752
Cumulative net cash flow	-340000	-190000	-28200	146752	
ROI Rate of investment	23.68%				
Break even point	2.16 years (The cost will be recovered in 3 years) (174952-146752/174752)				

Table 1: Cost Benefit Analysis for Restaurant Automation

Organizational Feasibility

The organizational feasibility study helped us identify the workability of the proposed system. Also, through market analysis, we have identified how well the people associated with the system, if built, are going to accept it.

Overall, the feasibility analysis has given us a green signal to proceed with the project with some associated risks.

Project Plan

To accomplish the project, a project plan has been created. Firstly, we have identified the best methodology, created a work plan and staffing plan, and have established the mechanism to maintain and control the project by designing the Project Control Process.

Project Methodology

As the project objective of automating the restaurant is a big and innovative project, we have decided to go with the agile rather than the waterfall methodology. The agile methodology is going to support the project because of the following reasons:

- Building a robot is an iterative process, sometimes few changes are required to be made to make things work. Hence, we will get the flexibility to change or to accept the suggested change through agile.
- Unlike conventional projects, this project involves intermediate testing sessions to test the functionalities or the capabilities of the robot. The waterfall methodology would have restricted us to test the system before it is completely ready. Hence, we selected the agile methodology.
- Agile supports modular development which is the basic requirement for this project.
- Using this methodology is going to be helpful as developing, customizing and installing a robot requires a collaboration-friendly work environment.

Risk Analysis

Risk is something that exists in every step of the project in one or the other form and therefore becomes an important factor which should be taken care of. Project Risk Analysis is a process that enables identification, analysis, and management of the risks associated with a project. Properly undertaken, it will increase the probability of a successful completion of the project according to the budget, schedule, and performance objectives. Risk Analysis is further divided into two stages. One is the qualitative analysis, focused on identification and subjective assessment of risks and the other is the quantitative analysis that focuses on an objective

assessment of the risks. After the risk is identified and analyzed, a contingency plan to deal with risks should be established.

After analyzing all of the project process, we identified the following associated risks:

Cost Risk

Due to the regular changes in the cost of the equipment and other raw materials, the actual cost of our project may go beyond the available budget. We will carefully analyze all the factors before allocating the budget for the project and also will have backup funding for any such situation.

Mechanical Breakdown Risk

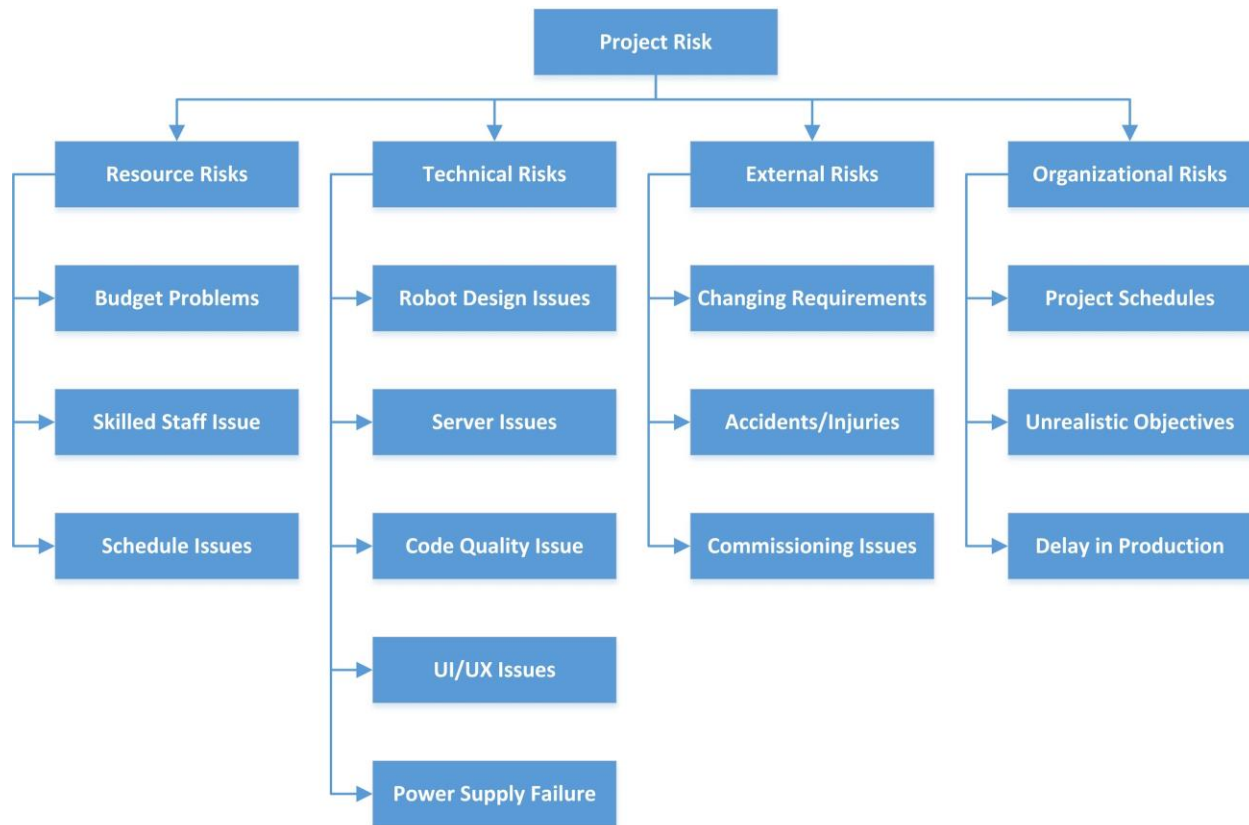
Breakdowns and failures are common in any machinery. We will make sure our robots are durable and resistant by running different tests both technical and physical to ensure that our robot can withstand harsh restaurant conditions like heat, moisture, grease, general collisions etc. We also will have a response team who will take care of any system/robot malfunction.

Commissioning Risk

Whenever installing a new device or technology, there is always a risk to approval failure in commissioning. To avoid any such risk, we will build the robots as per the government approved standards.

Accidents and Injury Risk

During the testing and the installation of the robot system, there is a probability of accidents and injury. To mitigate these, we will have first-aid kit, fire extinguishers, and an emergency power cutoff installed in place. Also, we will bring in a staff doctor during the testing and installation process.

Risk Breakdown Structure*Figure 3: Risk Breakdown Structure*

Risk Assessment Matrix

Identified Risks	Potential Response	Cause	Category	Priority	Urgency
Robot Design failure	Conduct design analysis & improve the design	Improper work instructions	Design Risk	High	High
Delay in production	Analyze and improve the process	Obstruction in production	Operational Risk	High	Medium
Inefficient robot Programming	Continuous check and improve the functionality	Improper Code Quality	Design Risk	High	High
Unrealistic budget and schedule	Business-case analysis; incremental development; look for additional sponsors; modification of schedule and budget	Improper project planning and budget allocation	Resource Risk	High	Medium
Constant alteration of requirements	Increased threshold for changes; incremental development; change management process; change control board	Unclear user requirements	Resource Risk	High	Medium
Power supply Failure	Parallel arrangement of batteries and power units	Overloading on power supply	Technical Risk	Low	Medium
Skilled Labor Issues	Improve hiring process	Not interviewing candidates properly	Resource Risk	Medium	Medium
Accidents (Fire, Injury)	Apply emergency measures and bring in a staff doctor	Mishandling of equipment	Operational Risk	Low	Medium
User interfaces do not fit needs	Prototyping; development of scenarios; User involvement	Complex UX Design and bad user flow	Technology Risk	Medium	High
Server Issues	Regular updating and maintenance; Using parallel server when main server is down	Technical Issues; Server crash due to overload	Technology Risk	Medium	High
Commissioning Issues	Ensure all systems & designs meet regulations and legal requirements	Careless consideration of regulations	Legal Risk	High	Medium

Table 2: Risk Assessment Matrix

Work Plan

Work Breakdown Structure

First phase of the project will be the project initiation, in which the feasibility analysis, client meetings, and business license will be delivered. In the second phase, planning phase in

which we define project plan, project staffing plan, project schedule, risk analysis, and mitigation. The details in the planning phase will help in the analysis/design phase of the project. In the third phase, which is design phase there are four important parts; first is floor layout of the restaurants and navigation design for the project. After that the circuit diagram of the robot and the design for the robot is made. Lastly, in the design phase, the test cases are made which will help in the testing phase of the robot.

Then comes the implementation phase of the project, this implementation phase will be divided into two phases. In the first implementation phase, the robot is implemented. In order for the robot to work we need to setup a navigation plan for the robot. This will help us to figure out how the robots will follow the track in the restaurants. The robots that we are going to make is the line follower in which the robot will have a reading mechanism at the bottom of the robot. Whenever the food is to be delivered to a particular table the robot follows the line to the table. When the robot reaches to the table there is code for that particular table. The robot reads the code if the code matches the food is delivered to the table or else the robot follows the path to the next table. Moreover, for the robot to read the code and follow the line as instructed we need to program the robot accordingly.

After the programming is done we need to test the robot as per the test case we will create in our design phase. In the test phase we will have two tests for the robot, first is physical test and second is functional test. After both tests are cleared we update the system per the test results to eliminate any errors. After the test phase is done the last phase is maintenance and control phase. In this phase the robot's maintenance is done i.e. if the robot's circuit fails or if the robot is having issues with reading the table code right then the maintenance team will look into the issue to come

to a solution. Then we will provide the full operational and safety training modules for the restaurants to provide the understanding of how the robots are going to operate in the restaurants.

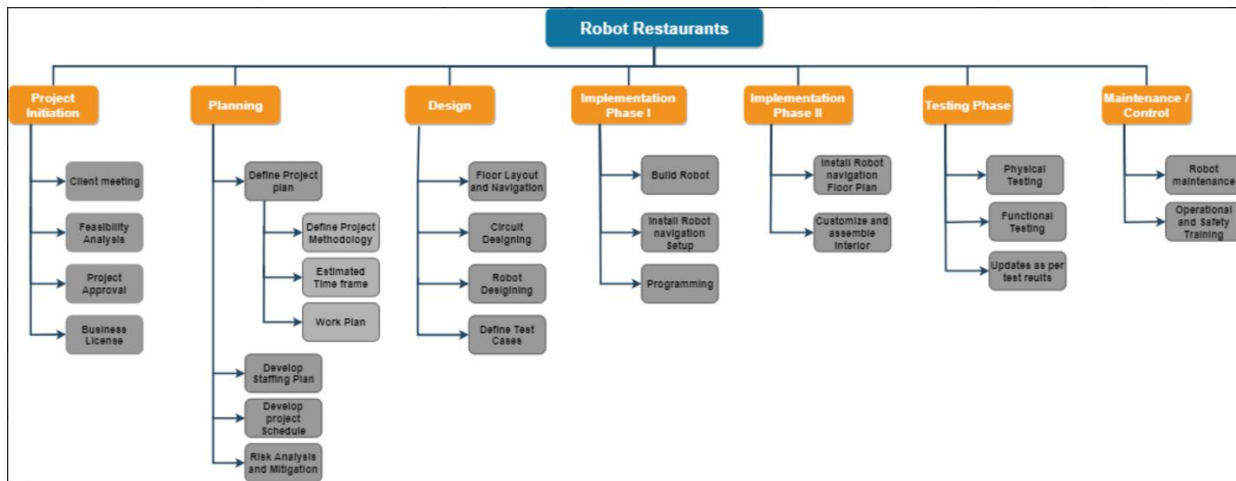


Figure 4: Work Breakdown Structure - Robot Restaurants

Schedule

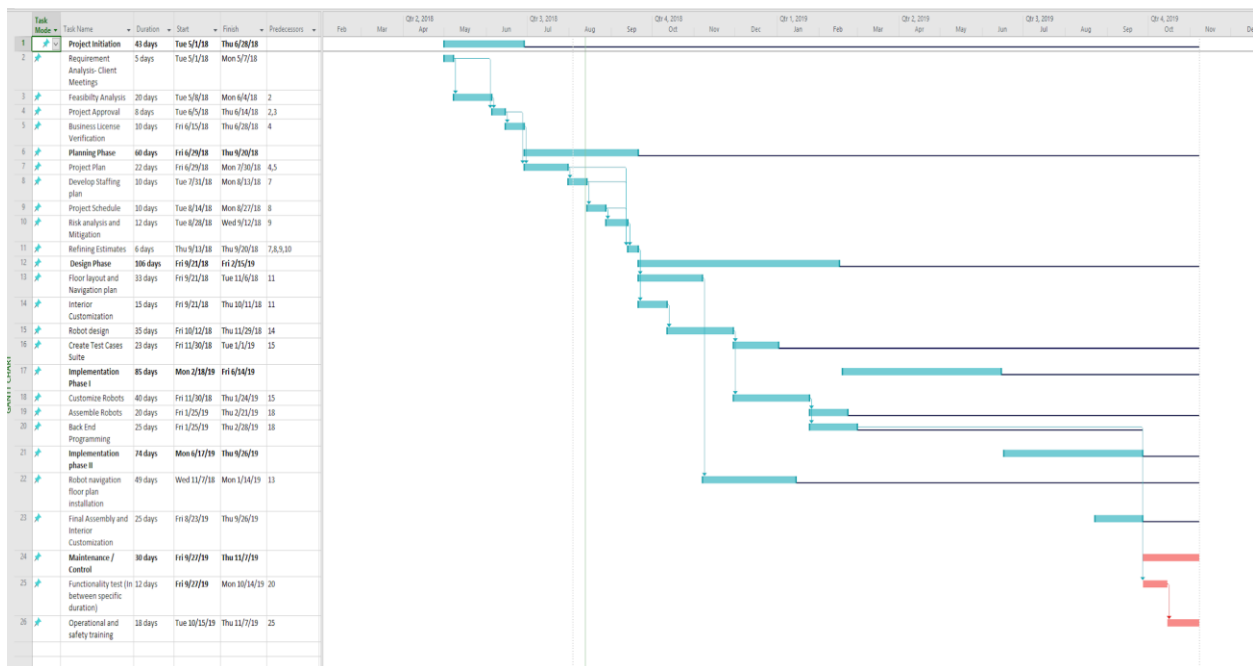


Figure 5: Text WBS and Gantt Chart

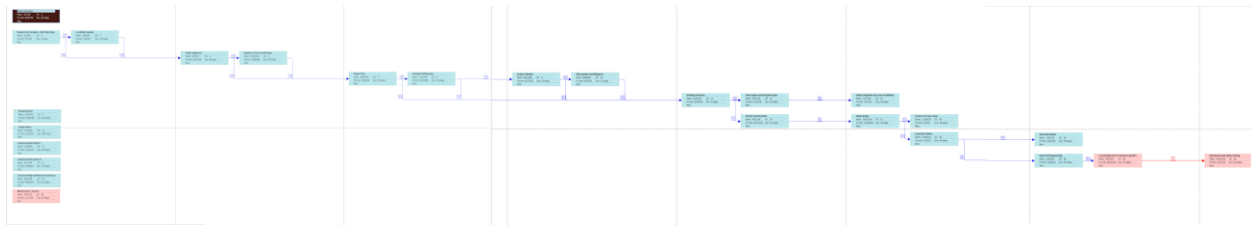


Figure 6: Network Diagram

Note: Please zoom in on Figures 4, 5 and 6 for more clarity.

Project Control Process

Project controls are the data gathering, management, and analytical processes used to predict, understand, and constructively influence the time and cost outcomes of a project. It also helps the project manager to evaluate the project's progress against the triple constraint of cost, scope, and time and hence assist effective management and decision making (Admin, 2018).

We will use the project control process to ensure our project is on schedule and the triple constraint is properly balanced. For this we will first create the Project Initiation Document (PID) and will present it to the stakeholders for approval. Once approved, we will start the project and allocate the resources for different phases of the project. As the project moves to the build phase, we'll have a two-week reporting period. In this time we will collect the information about current status of all the important aspects of the project like finances, design and project schedule.

In project financials, we particularly will check for the available budget. If the budget is sufficient to complete the project successfully, then we will take no action. If the budget is exceeding beyond the allotted limit, we will use the backup funding to compensate the extra cost.

As our robots will directly be interacting with the human customers, safety becomes the most prominent aspect for the project's success. To ensure the safety of the customers and ease of interaction with the robots, we will run continuous tests on our robots and will keep improving the design till the tests results are satisfactory.

Apart from the financials and the safety, delivering a project on time is also of significance. To do this, we will keep a track of the project schedule. Data will be collected about the project's status bi-weekly and will be compared with the original project plan. If any tasks are found to fall behind in the project, the schedule will be altered for all of the following tasks to ensure the project delivery in the promised timeframe.

This project control process will help us to monitor the triple constraint and manage them for the successful and timely completion of our automation project.

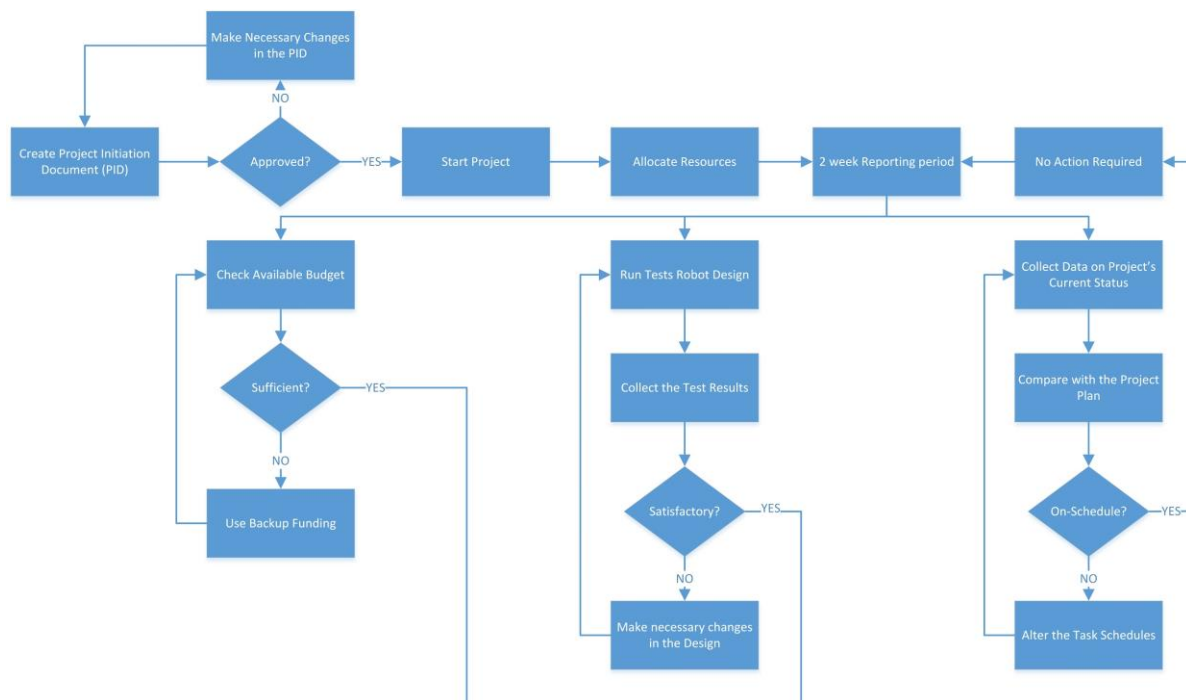


Figure 7: PCP Diagram

Resource Allocation and Staffing Plan

When discussing the responsibilities matrix, there are usually only a few different parties involved with management since there isn't a lot of roles. When using the previously discussed WBS for management that we made, simplifying it, below diagram depicts the project hierarchy considering the concluding work process after the successful implementation.

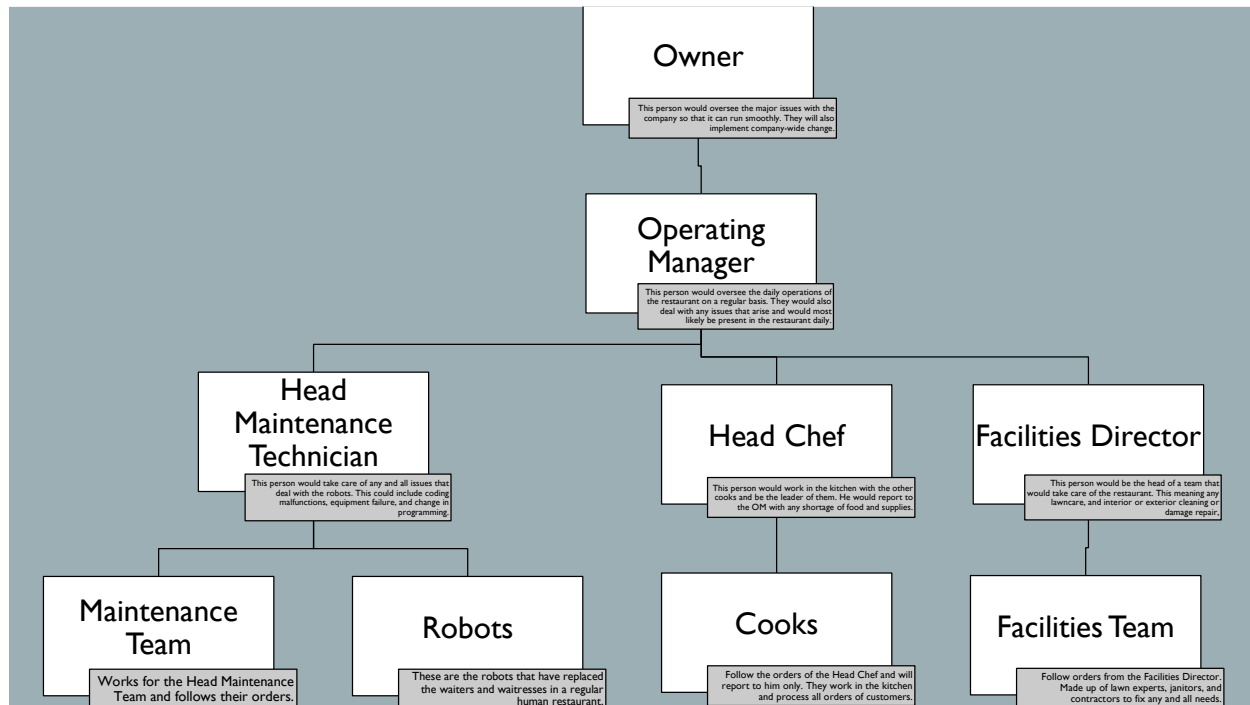


Figure 8: Project Hierarchy

This hierarchy is very similar to a normal restaurant but the responsibilities are slightly different and there is a new branch under the OM that is responsible for the robots. They take care of all of the issues that could arise with the use of robots in a restaurant. In a normal restaurant matrix, these responsibilities would be minimalized to the small electronic devices that are found in a normal restaurant and would most likely fall under the Facilities Director as a separate branch.

Along with the responsibility matrix, there are specific resources that need to be divided out differently to fit this hierarchy. There will also be different resources necessary since there are different requirements for robots than there are humans. The quantified values can be obtained once the restaurant starts to function after the completely automated wait staff. However, an estimate of the necessary resource budgets for each of the discussed branches above. The estimates were generated based on gross profit of \$1,000,000 for the year. This means these costs would be multiple depending on how much gross profit the company actually did make and is just a baseline to go off of our projections after opening. Below is the same matrix just with different descriptions.

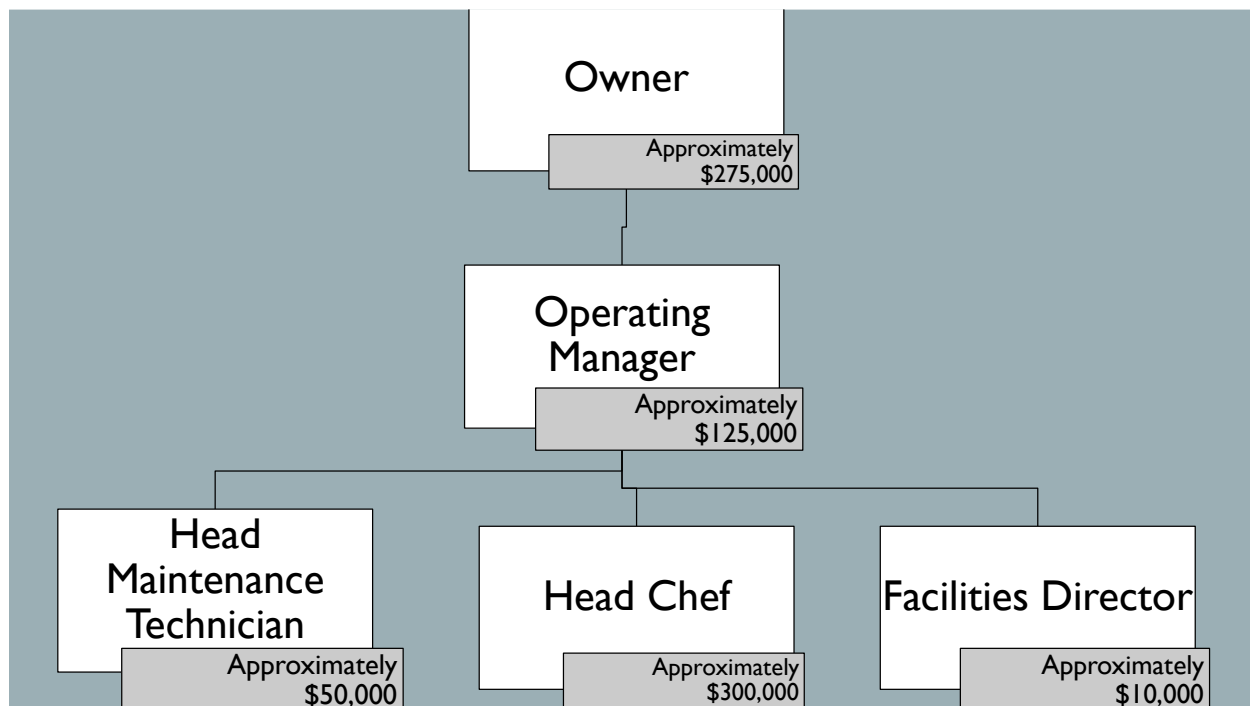


Figure 9: Budget Allocation by Department

The Owner's resource budget is usually going to be the largest since a lot of the biggest factors will fall under their domain. However, in the restaurant business, usually the food and beverage costs are the highest due to their quantity. The Owner's budget of approximately

\$275,000 for resources includes property tax and insurance, administrative expenses, salaries, employee benefits, and utilities. The salaries are going to be a lot cheaper than at other restaurants without robot waiters and waitresses is because these robots do not require a salary and their maintenance cost is most likely going to be less than a human's salary. The Operating Manager's budget would be something around \$125,000 which would include marketing, utilities, direct operating costs, and any entertainment we would provide.

The rest of the budgets and required resources would fall under the Operating Manager but this is a more broken-down analysis to talk about where some of these costs fall. For the Facilities Director their budget would be around \$10,000 and would include repairs and maintenance. The Head Chef would have a budget of approximately \$300,000 that would include food and beverages. Lastly the Head Maintenance Technician would have a budget of approximately \$50,000 that would include repairs and maintenance for the robots. The cost of the original robot equipment would be an upfront cost and not a yearly cost. All of the rest of the workers will fall under one of these branches and their budget and resources will come from their branch head. This gives a yearly cost of \$760,000 for the restaurant and a profit of \$240,000 before income tax. All of these figures are based off of an existing business that one of the team members works for.

Project Team and Management

In our restaurant we identified our Project Manager as the Operating Manager (OM) who oversees all of the daily operations of the restaurant. They will act in the go-to person in case any customer has any complaints about the quality of the food, long wait times for food, issues with the robots, etc. We would look for this person to have some experience in the food business and a managerial role. We would look for this person to have a compassionate personality with a very

high work rate and quality of work. If an individual has had some experience in a previous job working quality assurance and quality control that would be a plus. Something like this would help the OM be able to set standards for food procedures and plate visuals when they come out of the kitchen and be able to hold their employees accountable to meeting those standards. We would also look for this person to be personable and have a likeable personality. This would be necessary since they would need to be able to communicate with the rest of the staff and the customers. If we had someone who was not very nice or compassionate, then an interaction with a customer could be hurtful to the restaurant itself if they happen to write a review on the internet somewhere. Lastly, we would like for this individual to be tech savvy so that they can be able to learn our systems quickly and be able to keep up with the changes in technology especially with the robots and our scheduling and tracking systems. All of these roles would be necessary for a successful OM to have for our restaurant to be able to succeed.

Along with the OM, we would look for certain qualities with the members underneath him that run each of the branches. For each of these head positions, we look for similar characteristics in terms of personality, but the actual skills we look for will vary since each has specific responsibilities. For the Head Chef, we look for the ability to lead a kitchen and previous Head Chef experience in another location. We look for someone who has the ability to plate food at an extremely high-quality level. Since we will have robots as waiters and waitresses, it can make the atmosphere seem like a much higher quality and therefore the customers will expect a much higher quality food. For the Facilities Director, we look for someone who has the knowledge on how a building is built and run and all of the different appliances. This person could have previous jobs as a facilities director, or in construction where they would have the knowledge to understand all of the different aspects of a building and could have the ability to direct their team to repair and

maintain the building. This can range from appliances breaking to floor tile, ceilings, lights, fixtures, walls, etc. This would be necessary as things to break and fall apart in restaurants. Lastly, the Head Maintenance Technician would need to be tech savvy to understand the robots, and have a background in computer science to understand the programming of the robots. They would also need to have the technical knowledge to be able to work on the robots. The best candidate would be someone who has a robotics engineering degree which is comprised on computer science, mechanical engineering, and electrical engineering which are all aspects of the robots. Then for each of their team members, we would look for similar qualities so that they can have the same knowledge on how to perform their tasks.

Reporting and Documentation

In the restaurant business, there are a lot of documentation standards that are necessary for a business to follow government and state laws. Some of the documenting procedures would be caught through the point of sale systems like the number of customers, generated revenue, and product sold. This will help keep track of food inventory, which robots are performing and which are not, and the total revenue generated for the day. This will help with ordering food and beverages so the right quantities can be ordered and there is no overstock. Another documentation procedure would be the cleaning and sanitizing procedures and dates for the cooking equipment. This would show how well and the last time the kitchen was cleaned and the rest of the restaurant. Our restaurant would also need to keep track of orders of food and storage and receipts of orders so that we can make sure that old food is not getting served. We would also need to keep a log of when food gets frozen, when it gets thawed, and when it gets cooked so that everything is

documented properly. Lastly, every year, we would implement an after/before hours training session food safety so that all of the chefs and management are up to date on the latest protocols.

With all of our strict protocols of documentation for the kitchen, we would also have very strict procedures for cooking in the kitchen. Such procedures would be using the right equipment, wearing gloves, changing gloves after touching raw meat, and making sure the floor and workplace stay clean to prevent tripping or slipping hazards and cross contamination. All of these would be proper and protect the restaurant from transmitting diseases or getting people sick and will also prevent worker disability as it minimizes the risk of people getting hurt or sick.

The last major protocol that we would implement would be the cooking procedures and how to cook the different dishes on the menu. We would have a big training session for the chefs when they get hired to make sure they understand that every dish needs to be the same so that we are serving the same dishes every time. We would want our customers to have the same experience and the same dishes every time they come to the restaurant. If our dishes do not match or are very similar in appearance, taste, and quality then the customers will not want to come back. The dishes should be produced the same every time and the Head Chef will have a big part in monitoring the outcome of the dishes and the quality of the dishes.

Finances

When we try to analyze the total costs per year for the restaurant with robot waiters and waitresses, there are different aspects we need to look at since the costs will be slightly different. For this budget analysis, we will need to breakdown the different departments so that we can get an in-depth analysis.

Kitchen

In the kitchen, we have the head chef and then the regular chefs that work for them. According to Indeed.com, the average salary for a head chef is \$42,439 per year (Glassdoor.com, 2018). For the chefs that work underneath him, the average pay is \$14.81/hr. (Indeed.com, 2018) which equates to \$30,804.80 per year. Multiply this by approximately 4 chefs is a total of \$123,219.20 for all the chefs. This equates to a total chef salary cost of \$165,658.20 per year. On top of this, we have the food cost. With our budget, we then have \$134,341.80 for the food cost for the year. This should be enough to get us off the ground and then as we continue to grow, we can then put more of the money into the food cost.

Administrative Costs

For this we have rent and their salary are the big budget impacts here. Depending on the location, quality, and size of our restaurant, the rent per month amount will change. If we use Worcester, MA as our location and the average national restaurant floor space (~3,000 ft²) (Perkins, 2018), we end up with a monthly value of roughly \$75,000 per year. This is based off the average monetary value per square foot of a restaurant of \$25.00/sq. ft. /yr. (Cityfeet.com, 2018). This combined with the average salary of a restaurant manager comes to \$69,303 (Glassdoor.com, 2018).

Expense Breakdown

Below is a matrix breakdown of the different departments and their general expenses to get an overall quantity for the company. All of these values were generated from averages taken from Glassdoor.com.

Department Breakdown					
	Labor Cost	Total Hours	Supplies Cost	Quantity	Total Cost
Operating Manager	-	-	-	-	\$11,140
Rent	-	-	-	-	\$3,000
Technology Equipment	\$ 15.00	16	\$600	4	\$ 2,640.00
Tables/Chairs	\$ 250.00	10	\$300	10	\$ 5,500.00
Head Maintenance Technician	-	-	-	-	\$28,030.00
Robots	-	-	\$ 5,000.00	3	\$ 15,000.00
Robot Replacement Parts	-	-	\$ 3,000.00	3	\$ 9,000.00
Tools	\$ 15.00	2	\$ 2,000.00	2	\$ 4,030.00
Head Chef	-	-	-	-	\$25,400.00
Cooking Equipment	-	-	\$ 25,000.00	1	\$ 25,000.00
Equipment Cleaning	\$ 50.00	8	-	-	\$ 400.00
Facilities Director	-	-	-	-	\$10,000.00
Lawn care	-	24	\$ 5,000.00	1	\$ 5,000.00
Building Repairs	\$ 20.00	-	\$ 5,000.00	1	\$ 5,000.00
Total Costs					\$74,570.00

Table 3: Expense Breakdown Table

These are all based on averages from the different departments which were generated from Glassdoor.com. Some of these costs, like the robots and cooking equipment, would be a 1 time buy to start the business but then would be replaced after many years of use. In total, the first year would be roughly \$75,000 to get the business started.

For our specific system, we would use a TBC kind of budget since this would make the most sense for our restaurant. This would be perfect since we would allocate different amounts of money to the different departments for them to complete their work. If that department did not use all of their funds or required more, we would need to have an administrative discussion to determine the importance and severity of the issue that needs to be addressed. If they do not use all of their funds, we can carry that into a rolling emergency fund so that we have some money to take from in case of emergency.

Conclusion

As we stated in the beginning, this is an innovative part of the food service industry and can provide the opportunity for the industry to increase its profit margin significantly. This in turn can make food at all different restaurants cheaper and more affordable. This being said, we did a lot of research into how this would work and what is needed for this to be accomplished. Upon doing this research we determined this is completely feasible financially and realistically. If we can get this design to market and generate a proven method that works, we can then implement the same design foundation to any restaurant around the globe. If this comes to success and is very efficient and an obviously better option than having humans, this same foundation can then branch out to other industries such as hotel check in desks, secretaries, and many other industries. This is on the edge of innovation and a promising direction as it has already started in certain areas of the globe. Continuing the research with Atmega Automation and ourselves can lead to any company being at the forefront of innovation and leading change and completely change a company's future.

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Figures:

Figure 1 – Self made

Figure 2 – Xie, Qin. “Pizza Hut Introduces Robot Wait Staff.” *Daily Mail*, Dailymail.com, 1 Sept. 2016, www.dailymail.co.uk/video/news/video-1294275/Pizza-Hut-introduces-robot-wait-staff-restaurants-Asia.html.

Figure 3 – Self made

Figure 4 – Self made

Figure 5 – Self made

Figure 6 – Self made

Figure 7 – Self made

Figure 8 – Self made

Figure 9 – Self made