

CONTEXT:

HUMAN RESOURCES

For this project, we are considering hiring the following people:

- ➔ UX/UI Designer (who will be in charge of designing the program and the user interface)
- ➔ Database designer (in charge of the data capture module)
- ➔ Data analyst (in charge of the analysis engine module)
- ➔ Programmer with experience in APIs (in charge of the order execution module)
- ➔ 1 Programmer and 1 finance expert (in charge of the risk management module)
- ➔ 1 Project Manager (in charge of documentation, dealing with the client and in charge of the project in general)

In total 6 employees and the project manager.

MONEY

- The 6 employees will receive the same salary of \$1,000 USD monthly.
- The project manager will earn \$2,000 USD monthly.
- \$500 USD will be used to pay rent, electricity and other expenses.
- A percentage of the final project cost (20%) will be added as a risk budget. This percentage will be included in the final budget, and will serve as a margin for possible mistakes and incidentals that may come up throughout the execution of the project and that are not attributed to changes in specifications by the client.

TIME

The estimated time at the beginning of the project is 6 months.

BUDGET

By having 6 employees with a monthly salary of \$1,000 USD and a Project Manager with a monthly salary of \$2,000 USD and \$500 USD for expenses, gives us a total of \$8,500 USD per month.

$$6 \times 1,000 = 6,000 + 2,000 = 8,000 + 500 = 8,500$$

The estimated time is 6 months, so \$51,000 USD will be required just to cover salaries and expenses.

$$6 \times 8,500 = 51,000$$

Adding 20% of the risk budget (\$12,750 USD), the final total cost will be \$63,750 USD.

$$\frac{51,000}{80\%} \approx \frac{X}{100\%} = 63,750$$

Changes

CR1	The client requests new functionality for trading in the real market and real-time assessment of the trader's decision. It includes an analysis with the timing of 1 minute and provides reasoning on if the trader's decision was good or wrong
CR 2	The client requests to include three new trading algorithms; the first is based on quantum computing, the second in elliptic curves, and the third on convolutional neural networks.
CR3	The client requests the implementation of the most successful investments and the worst investments per day, per week, and month.
CR4	Due to government regulations, the system should send a monthly encrypted signed report with all transactions performed during the day, week, and month.

CR1

The client requests new functionality for trading in the real market and real-time assessing of the trader's decision. It includes an analysis with the timing of 1 minute and provides reasoning on if the trader's decision was good or wrong.

Configuration Identification:

- Code [+Add a new function](#)
- Design [+ Add a new screen with 1 minute analysis](#)
- Documentation [+ Add the new specifications](#)

Affected modules:

Four of the five modules will be directly affected by client changes.

- ➔ **User Interface (UI):** The software could feature an intuitive user interface that allows users to configure and monitor strategies, view performance reports ([real-time analysis will need to be implemented for 1-minute operations](#)), and make adjustments as needed.
- ➔ **Data Capture Module:** This module would be responsible for obtaining real-time data from multiple market sources, such as stock exchanges and data providers. It would use APIs to access this data.
- ➔ **Analysis Engine:** The analysis engine would process and analyze market data to identify relevant patterns and signals for trading strategies. ([updates will need to be implemented in periods of 1 minute](#))
- ➔ **Order Execution Module:** This module would connect to trading platform APIs to automatically execute buy and sell orders based on defined strategies. ([A new type of market order will be implemented that allows the trader to operate manually](#))

- **Risk Management:** A critical component would be the risk management module, which evaluates the risk associated with each trade and applies measures like loss limits and stop-loss to protect the investment. (A new function will be implemented that evaluates if the trader's decision was good or wrong)

Risk assessment:

These changes will imply an increase in time, and consequently in money. Therefore the budget must be updated.

- **Effort.** Time and budget increased **16.66%**.
- **Time.** It will be necessary to increase **one month** of work to the time that was contemplated.
- **Money & Budget.** By having 6 employees with a monthly salary of \$1,000 USD and a Project Manager with a monthly salary of \$2,000 USD and \$500 USD for expenses, gives us a total of \$8,500 USD per month.

$$6 \times 1,000 = 6,000 + 2,000 = 8,000 + 500 = 8,500$$

The new estimated time is 7 months, so **\$59,500 USD will be required just to cover salaries and expenses.**

$$7 \times 8,500 = 59,500$$

Adding 20% of the risk budget (\$14,875 USD), **the final total cost will be \$74,375 USD.**

$$\frac{59,500}{80\%} \approx \frac{X}{100\%} = 74,375$$

- **Human resources.** For this particular client request it won't be necessary to hire more qualified workers.

CR2

The client requests to include three new trading algorithms; the first is based on quantum computing, the second in elliptic curves, and the third on convolutional neural networks.

Previous analysis

This particular change request actually includes 3 different requests, so it is necessary to separate them to evaluate each one in particular:

CR2.1

The client requests to include a new trading algorithm based on quantum computing.

Particular analysis: Quantum computing

Quantum computing is a computing paradigm different from classical computing. It is based on the use of qubits, a special combination of ones and zeros. The bits in classical computing can be 1 or 0, but only one state at a time, while the qubit (quantum bit) can have both states simultaneously. This gives rise to new logic gates that make new algorithms possible.

Physical support

The problem of which physical medium would be ideal for quantum computing has not yet been resolved. A series of conditions have been defined that it must fulfill, known as Di Vincenzo's list, and there are currently several candidates.

Google engineers are still working on a quantum processor.

***For these reasons, this particular change request is impossible to make, at least for the moment.**

CR2.2

The client requests to include a new trading algorithm based on elliptic curves.

Particular analysis: Elliptic curves

In 1985, mathematicians Neal Koblitz and Victor Miller independently presented a proposal to use elliptic curves on finite fields in the development of encryption schemes. To understand what elliptic curve cryptography (ECC) is, it is necessary to first review the concept of what elliptic curves are as such.

In cryptography, elliptic curves based on real numbers are not used, as this causes rounding errors in computers. For this reason, elliptic curves defined on finite bodies are used, which can be represented by the following equation:

$$y^2 = x^3 + 10x + 2$$

This elliptic curve cryptography is characterized by having a finite number of points, whose coordinates will only be integers. This characteristic is of utmost importance for this encryption algorithm, since it allows calculations to be made efficiently and without rounding errors.

There are two types of finite fields that can be used in elliptic curve cryptography:

- **Prime bodies**, which have a prime number of elements.
- **Binary bodies**, which have a number of elements that is a prime power of 2.

The way in which another point on the curve is obtained by this method is by adding a point (x, y) many times with itself. So that:

$$Q = P + \dots + P = n * P$$

Encryption algorithms are usually based on mathematical problems whose solution has not yet been found. This ensures that the feature is not reversible at the hands of a malicious third party.

In the case of RSA encryption, its security is based on the mathematical problem of factoring integers, which means that it is too difficult to factor a very large integer into prime numbers. It is said that this cryptographic system will be able to break with the technology of quantum computers. Therefore, more alternatives have emerged to anticipate this factor.

Elliptic curve cryptography is based on the elliptic logarithm problem, also known as the discrete logarithm problem on elliptic curves. This problem could be defined as follows:

Given a point on the curve Q, obtained by multiplying an integer n and a point P:

$$Q = n * P$$

The problem is that it is very difficult to find n from two known numbers P and Q. To date, a solution has not yet been found, which means that this algorithm continues to be cryptographically secure.

Configuration Identification:

- Code +Add new encryption feature (back end)
- Design (interface or front end will not change)
- Documentation + Add the new specifications for encryption

Affected modules:

One of the five modules will be directly affected by client changes.

- **User Interface (UI)**
- **Data Capture Module:** It will be necessary to implement encryption measures on sensitive data in databases.
- **Analysis Engine**
- **Order Execution Module**
- **Risk Management**

Risk assessment:

These changes will imply an increase in time, and consequently in money. Therefore the budget must be updated.

- **Effort.** Time increased **25%** and budget increased **39.7%**.
- **Time.** It will be necessary to increase **one month and a half** of work to the original time.
- **Human resources.** For this particular client request it will be necessary to hire **one** qualified employee expert in cryptography.
- **Money & Budget.** By having 7 employees with a monthly salary of \$1,000 USD and a Project Manager with a monthly salary of \$2,000 USD and \$500 USD for expenses, gives us a total of \$9,500 USD per month.

$$7 \times 1,000 = 7,000 + 2,000 = 9,000 + 500 = 9,500$$

The new estimated time is 7.5 months (30 weeks), so **\$71,250 USD will be required just to cover salaries and expenses.**

$$7.5 \times 9,500 = 71,250$$

Adding 20% of the risk budget (\$17,812.5 USD), **the final total cost will be \$89,062.5 USD.**

$$\frac{71,250}{80\%} \approx \frac{X}{100\%} = 89,062.5$$

CR2.3

The client requests to include a new trading algorithm based on convolutional neural networks.

Particular analysis: Convolutional neural networks

A Convolutional Neural Network (CNN) is a type of artificial neural network designed for working with data that comes in a grid-like structure, such as images. CNNs are commonly used in computer vision tasks, pattern recognition, and image processing.

In CNNs, there are specific layers that automatically learn features and patterns from the input data, especially images. Some important parts of a CNN include:

1. **Convolutional Layer:** This layer applies filters (kernels) to parts of the input image to detect features like edges, corners, and textures. Each filter creates a feature map that highlights a specific feature.
2. **Pooling Layer:** Also known as the subsampling layer, it reduces the resolution of feature maps, which reduces the number of parameters and computations in the network. Subsampling helps to retain important features while reducing data redundancy.
3. **Fully Connected Layer:** After the convolutional and pooling layers, the extracted features are flattened and connected to fully connected layers that perform tasks like classification or regression.
4. **Activation Functions:** Functions like ReLU (Rectified Linear Unit) are used in the convolutional layers to introduce non-linearity into the network, improving its ability to learn.

CNNs have proven to be very effective in various applications, including image classification, object detection, image segmentation, and more. Their success is largely due to their ability to learn hierarchical features, allowing them to recognize complex patterns in visual data.

CNNs are widely used in fields such as computer vision, medical image processing, autonomous vehicles, image classification on social media, and many others.

Configuration Identification:

- Code +Add new module
- Design + Add a new screen of the convolutional neural networks module with its new functionalities
- Documentation + Add the new specifications for code and design (backend and frontend)

Affected modules:

All of the five modules will be directly affected by client changes. In addition, it will be necessary to create a new module:

- **User Interface (UI):** A new screen will be required with all the new functionalities.
- **Data Capture Module:** A new table will be needed to be created in the database with relations to the new module.
- **Analysis Engine:** The original analysis will be complemented by the convolutional neural network.
- **CNN Module:** Will be necessary to create this new module.
- **Order Execution Module:** This module will be affected by the new module in automatic orders.
- **Risk Management:** This module is directly related to the analysis engine module, and now it will be necessary to manage risk using the new module as well.

Risk assessment:

These changes will imply an increase in time, and consequently in money. Therefore the budget must be updated.

- **Effort.** Time increased **50%** and budget increased **67.64%**.
- **Time.** It will be necessary to increase **three months** of work to the time that was contemplated in the initial context.
- **Human resources.** For this client request it will be necessary to hire **one** qualified employee expert in Convolutional Neural Network .
- **Money & Budget.** By having 7 employees with a monthly salary of \$1,000 USD and a Project Manager with a monthly salary of \$2,000 USD and \$500 USD for expenses, gives us a total of \$9,500 USD per month.

$$7 \times 1,000 = 7,000 + 2,000 = 9,000 + 500 = 9,500$$

The new estimated time is 9 months, so **\$85,500 USD will be required just to cover salaries and expenses.**

$$9 \times 9,500 = 85,500$$

Adding 20% of the risk budget (\$21,375 USD), **the final total cost will be \$106,875 USD.**

$$\frac{85,500}{80\%} \approx \frac{X}{100\%} = 106,875$$

CR3

The client requests the implementation of the most successful investments and the worst investments per day, per week, and month.

Configuration Identification:

- Code + Add a new function with the best and worst results per day, week and month
- Design + Add a new screen with the new requirement
- Documentation + Add the new specifications on backend and frontend

Affected modules:

Four of the five modules will be directly affected by client changes.

- **User Interface (UI):** A new screen or button will be added with the best and worst results allowing the user to choose the timing.
- **Data Capture Module:** A new relationship will be necessary between the database tables, the execution orders module and the analysis engine module.
- **Analysis Engine:** It will be necessary to analyze each executed order and compare it with the other orders to be able to locate the best and the worst in different time units.
- **Order Execution Module:** A new relationship will be necessary with the data capture module.
- **Risk Management**

Risk assessment:

These changes will imply an increase in time, and consequently in money. Therefore the budget must be updated.

- **Effort.** Time and budget increased **16.66%**.
- **Time.** It will be necessary to increase one month of work to the time that was contemplated.
- **Human resources.** For this client request it won't be necessary to hire more qualified workers.
- **Money & Budget.** By having 6 employees with a monthly salary of \$1,000 USD and a Project Manager with a monthly salary of \$2,000 USD and \$500 USD for expenses, gives us a total of \$8,500 USD per month.

$$6 \times 1,000 = 6,000 + 2,000 = 8,000 + 500 = 8,500$$

The new estimated time is 7 months, so \$59,500 USD will be required just to cover salaries and expenses.

$$7 \times 8,500 = 59,500$$

Adding 20% of the risk budget (\$14,875 USD), the final total cost will be \$74,375 USD.

$$\frac{59,500}{80\%} \times \frac{X}{100\%} = 74,375$$

CR4

Due to government regulations, the system should send a monthly encrypted signed report with all transactions performed during the day, week, and month.

Configuration Identification:

- Code +Add new encrypted monthly report functionality
- Design +Add a new button or screen with the new functionality
- Documentation + Add the specifications with the new government regulations

Affected modules:

Two of the five modules will be directly affected by client changes.

- **User Interface (UI):** A new button or screen with the new functionality on the UI will be necessary.
- **Data Capture Module:** It will be necessary to implement encryption measures on sensitive data in databases and all the orders performed will be recorded and encrypted in the monthly report.
- **Analysis Engine**
- **Order Execution Module**
- **Risk Management**

Risk assessment:

These changes will imply an increase in time, and consequently in money. Therefore the budget must be updated.

- **Effort.** Time increased **33.33%** and budget increased **49.01%**.
- **Time.** It will be necessary to increase **two months** of work to the time that was contemplated.
- **Human resources.** For this client request it will be necessary to hire **one** qualified employee expert in cryptography.
- **Money & Budget.** By having 7 employees with a monthly salary of \$1,000 USD and a Project Manager with a monthly salary of \$2,000 USD and \$500 USD for expenses, gives us a total of \$9,500 USD per month.

$$7 \times 1,000 = 7,000 + 2,000 = 9,000 + 500 = 9,500$$

The new estimated time is 8 months, so **\$76,000 USD will be required just to cover salaries and expenses.**

$$8 \times 9,500 = 76,000$$

Adding 20% of the risk budget (\$19,000 USD), **the final total cost will be \$95,000 USD.**

$$\frac{76,000}{80\%} \approx \frac{X}{100\%} = 95,000$$

Change Request	Budget	Time	HR	Effort	Risk Expertise	Law Mandatory	First Approval	Ranking	Final Decision
CR1	16.66%	16.66%	0	16.66%	Medium	No	Approved	4	Rejected
CR2.1	-	-	-	-	-	No	Rejected	6	Rejected
CR2.2	40%	25%	1	32%	Low	No	Approved	2	Approved
CR2.3	67.64%	50%	1	58.82%	High	No	Rejected	5	Rejected
CR3	16.66%	16.66%	0	16.66%	Low	No	Approved	3	Approved
CR4	49.01%	33.33%	1	41.17%	Low	Yes	Approved	1	Approved

CR1	The client requests new functionality for trading in the real market and real-time assessment of the trader's decision. It includes an analysis with the timing of 1 minute and provides reasoning on if the trader's decision was good or wrong
CR 2.1	The client requests to include a new trading algorithm based on quantum computing.
CR 2.2	The client requests to include a new trading algorithm based on elliptic curves.
CR 2.3	The client requests to include a new trading algorithm based on convolutional neural networks.
CR3	The client requests the implementation of the most successful investments and the worst investments per day, per week, and month.
CR4	Due to government regulations, the system should send a monthly encrypted signed report with all transactions performed during the day, week, and month.

Decision Criteria

Because CR4 is mandatory by government regulations, although the cost is high in the budget, time and effort, it is something that needs to be implemented as soon as possible.

Therefore, if we do a detailed analysis of the new requirements, we can realize that CR4 will need an encryption algorithm, so the most efficient decision would be to use an elliptic curve algorithm (instead of RSA or more common algorithms) to at the same time perform CR2.2 without spending more resources, so just by making that decision, the cost of CR2.2 could be zero.

At the same time, doing the CR4, which is mandatory, we will have detailed information on all transactions by day, week and month, so doing the CR3 by locating the best and the worst investment in these time periods will be much simpler and less expensive than what appears in the table, because the table only considered making that requirement without taking into account any other.

Conclusions

I could say that if resources are used intelligently, being as efficient as possible, we could carry out 2 more requirements (CR2.2 and CR3) almost without spending resources.