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Mestrado em Gestão de Informação
Master Program in Information Management

Implementation of ANN in Software Effort Estimation: Boundary Value Effort Forecast

A novel Artificial Neural Networks model to improve the accuracy of Effort Estimation in Software Development Projects

by

Vusal Orujlu

Dissertation report presented as partial requirement for obtaining the master's degree in Information Management, with a specialization Information Systems and Technologies Management

NOVA Information Management School
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November 2021

ABSTRACT

Software Development consistently accommodates a variety of unstable scenarios. Good planning always stands behind well-defined requirements. Hence, the consistency of the effort estimation plays a special role in the traditional Business-Consumer relationship.

While the proposed models may provide high accuracy in predicting specific data sets, it's still difficult for IT specialists/organizations to find the best method for evaluating certain functionalities. The challenge of the project; initiated programming language, project infrastructure, and/or staff experimentation are just a few of the reasons that lead to inequality in these terms.

Conceptually, the planned work going to explicate the main correlations. It will contain historical background - as to how was the industrial lifecycle before pre-processing progress/what was the necessity for them to exist, as well as modern usage area of BPM and Project Management – like how managers and owners' moves are intending to keep the consumer's satisfaction in higher level while increasing the revenue.

Taking the most failure causes of projects into consideration, the research will capture some components of Software Project Management to clarify developed approaches and their advantages and/or disadvantages. The study may also lead somehow to the Business Process Management to see the alignments of required tasks in a rigorous way.

The research is generally intending to define the key features of the Project Effort Estimation as usage of the datasets, evaluating the architectures, etc. The investigation also aims to find effective causes of poor effort estimation and analyze how those improvable points may be developed to ensure a highly accurate Artificial Neural Networks model.

Keywords: Software Effort Estimation; Artificial Intelligence; Artificial Neural Networks; Project Management; Limiting Value Forecast; Business Process Management

LIST OF ABBREVIATIONS AND ACRONYMS

Acronym	Explanation of acronym
ANN(s)	Artificial Neural Networks
AUCP	Adjusted Use Case Points
CNN	Convolutional Neural Networks
EF	Environment Factor
FLANN	Functional Link Artificial Neural Networks
GRNN	Generalized Regression Neural Networks
LSTM	Long Short-Term Memory
NLP	Natural Language Processing
MNIST	Modified National Institute of Standards
RNN	Recurrent Neural Networks
SEE	Software Effort Estimation
SNN	Spiking Neural Networks
TCF	Technical Complexity Factor
UUCW	Unadjusted Use Case Weights
WMFP	Weighted Micro Function Points

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1. INTRODUCTION

"Though the challenges are unprecedented, and though the disagreements are intense, humankind can rise to the occasion if we keep our fears under control and be a bit humbler about our views'' (Harari, 2018)

As a result of the modern developments in the Science of Computer Systems, the world is already beyond dreams. Evidently, it takes a new and mysterious form with the applications of Artificial Intelligence day by day. AI is everywhere, and the influences are in every single life. As mankind has always tried to transform this labyrinth into a much more complex, at the same time pleasurable place, today's planet is experiencing its highest growth period of all time.

The technology flows downward belong to the speed stepwise. These principal effects can be observed and experienced like Project Management which has always been intertwined with modern innovations. With the aid of implementations of descriptive technologies, PM tries to stabilize only and only increment alignments. Since the paper will only be developed in the light of Software Development Projects, we will examine this specific area from now on.

As an effective and efficient development of the Software requires accurate forecasts, the reliability of the effort estimation of projects is an important aspect in terms of competition between the organizations. The prediction is an essential and compulsory mission of Project Management, which is the correct calculation of the necessary resources and the necessary software development projects calendar. (Muaz GÜLTEKİN, Oya KALIPSIZ, 2016)

Considering that methodology is given engaged within distinctive research traditions, the list of main steps includes five elements. The methodology starts from the concept of studied knowledge where it ends with the admission of a validated model. The main goal of this research was considered to build a model that can assure time estimation of a particular software project. The paper is going to acquire a good deal of information base relevant to fixed areas.

The research is directly related to the field of Software Effort Estimation (SEE), which unites Project Management activities and implementations of Artificial Neural Networks. The materials used to develop this paper, are taken from books, articles, reports, and some electron sources. The topic has been chosen and improved according to the concerns, and interests.

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1.1 MOTIVATION AND PROBLEM IDENTIFICATION

Unfortunately, it's not always realistic to calculate and evaluate the total schedule frame and reliably cost analysis in Software Development Projects. The reason for that is the complexities and difficulties of developers in the effort estimation stage**.** (Muaz GÜLTEKİN, Oya KALIPSIZ, 2016)

In contemporary society, Project Management – such with a wide range of usage areas, leads almost to every type of task, process, and activity set. This fact improves the flexibility of the area but also increases the cross-sectional complexity equally. Business Process Management plays a remarkable role in the improvement of customer satisfaction with the aid of giving opportunities to companies for increased efficiency not only with stressing on final service/product but also with concentrating on certain ongoing processes in producing cycle. Hence, sometimes improvements in processes may influence Project Management activities as well as the working attitude of managers and leaders in a positive manner.

It's not always uncomplicated and easy to maintain impeccable relationships between ongoing (BPM) and time-bound (PM) activities. Sometimes one missed deadline may occur the hundreds of delays dependently on relationships between those activities. Project Management indicates the essential measures to achieve a specific social and economic goal based on the stakeholders' needs on the way to improve production efficiency. (Kamil Ramisovich Bibarsov, Galina Ivanovna Khokholova, Dilara Ramisovna Okladnikova, 2017)

The well-defined projects should have a precision decision base in order to capture estimated time, budget, and resource alignments. The fundamental of these estimations lies behind the great process identification within the organization. Inside the modern and competitive world, the relational effects of BPM and Project Management are quite essential sciences to develop responsive and fluent systems and projects. At the first stage, the motivation criteria can be classified as a personal interest in technological innovations in the Project Management area and disruptive technics that may change the outlooks of managers and owners. Additionally, there are quite enough influential sides of Project Management life-cycle to discover. Lastly, as a one master tool of Machine Learning, it's a much attractive and instructive way to use the ANN algorithm to develop an early prediction model.

Today, organizations preferably execute processes that are mostly supported by IT. They are connected to external dependencies as well such as intermediary vendors, external payment systems, outsourcers, etc. Generally, good-organized business companies are bound by the established rules and governance of BPM. (Przedmiescie, 2019)

ANNs are known as very effective to deal with complex pattern-oriented problems. In the case of correct input identification (determined by capturing decision criteria used by domain experts for solving problems and eliminating correlated variables), Algorithm's heuristics may produce optimal generalization performance. (Steven Walczak, Narciso Cerpa, 2003)

So, considering the importance of all mentioned respectable points, it's understandable that to use Artificial Neural Networks is a useful and commendable approach for determining the pre-

considered time accuracy within the projects under the operational guidelines. During the dissertation work, I will try to compile the main methods, architecture designs while ensuring the input variable and training samples selections of ANNs.

The accuracy of projects is a major key component to keep durability and progression in all phases of the activity cycle. The wrong scheduling of work packages and relevant activities is one of the main causes of project failure. Although there are several software measurements programs to provide productivity and quality of previously given data, it's still hard to determine the cost and schedule overruns because of a lack of influential quality-cantered mechanisms. (Discenza, R. & Forman, J. B., 2007)

The recent research of 5,400 IT projects, conducted in cooperation with McKinsey Corporation and the BT Centre of the University of Oxford, proves that more than half of the Software projects get the result in cost overruns, and almost 33% of them comes to conclusion with schedule delays.

The organization community of McKinsey says: "*After concluding the research by comparing the results of budgets, schedules, and benefits, we realized that those projects had a price difference of about $66 billion between the planned and finalized efforts which is even more than Luxembourg's total GDP*." (Michael Bloch, Sven Blumberg, and Jurgen Laartz, October 1, 2012)

The next figure simply identifies the result of the investigation. Considering the problem in the industry, the thesis work will include the reasonable contents of this gap and propose the Artificial Neural Networks model to predict the future project's effort. We will define the method and the tool that will be used in the modification of networks.

Adequate techniques will be compared and evaluated with the current output. Achieving a high degree of model accuracy with the selected attributes is the most motivating factor for research. Therefore, during the literature review, I will also consider the hierarchy of different Neural Networks. These architectures will be described, and modern methods will be determined.

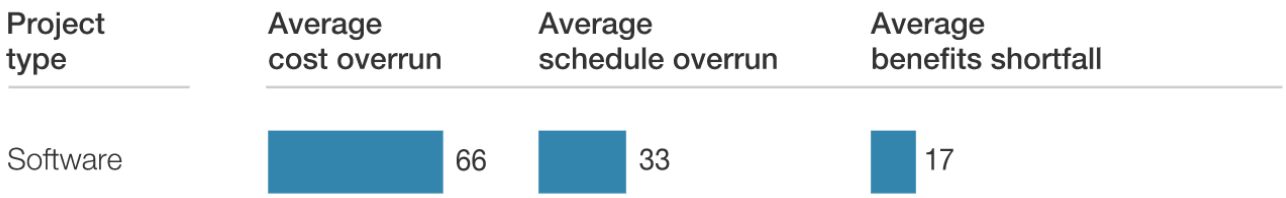


FIGURE 1. THE PERCENTAGE PERFORMANCE SCALE OF PROJECTS BY OXFORD UNIVERSITY

1.2 THE GENERAL OBJECTIVES OF THE RESEARCH

Managing high-complex project activities always requires adequate executive abilities. Now and then, managers may keep unconsidered work behind the high-priority decisions and unintentionally neglect the future project's success due to shifting desired deadlines and/or exceeding budget directives.

High accuracy was needed in the prediction observance. As time has passed and it became necessary to take advantage of AI, multiple developers suggested different effort estimation models for Software-based Projects. Despite this fact, it's still unknown which of those models may be an option for specific cases. The invention and improvements of ANN ensure well-defined architectures that are standing on special intentions in a given situation.

Figure x shows a simple activity template of Project Management. These development packages can include specific activities which contain specific activities that assign and schedule for future stages. Project Management can involve a wide variety of projects. So, even in the terms of Software Development, the requirements are always may differ. However, we can define custom templates of the key pillars of Project Management for activity analysis during research.

So, if there's an idea, new needs arise. The need triggers certain requirements that must be completed in order to reach the final output. This output is the project itself, in another word, the outcome that the Project Owner and Manager want to succeed.

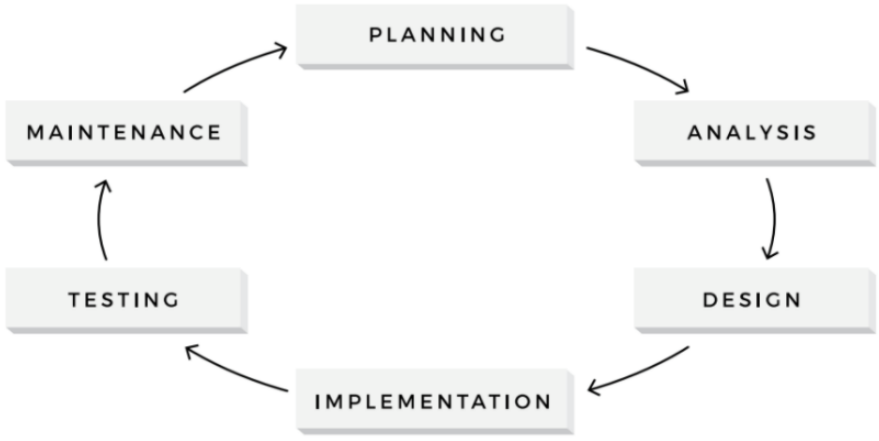


FIGURE 2 PROJECT ACTIVITIES METHODOLOGY (ALTEXSOFT, 2018)

Project Management has special goals and tasks which can be described under five dimensions in general view. To integrate the project, the chapter and management plan of the project must be defined. It's the primary step to start the project properly. It involves to schedule controlling, monitoring, and even performing the extraordinary tasks associated with control sessions. Once the integration part has been successfully characterized, work schedule management joins the process. Then, all important details of project scope and management requirements are defined. A special piece for our paper is also specified at this stage. Estimation of the effort of the project is also part

of this phase. We will be talking about different organizational approaches for this session in withing following chapters.

On this particular subject, the general objective and principal purpose of the research is to build an ANN model for early effort prediction. My intention with the creation of this particular model is to bring a new approach to become useful in the industry. To achieve this goal, special variables should be defined which ensure the initial components of the developed model. Those variables could only be detected after a wide literature review and experimental analyzes.

The scope of the remarked project is initially presented to clarify the intended objectives of the project, followed by the activities plan to define the project's milestones and activity schedule of the project. A project organizational plan was followed with the intent to structure the organization and indicate who is going to do what, and who is responsible for each activity to be carried out during the project.

Resource planning, quality assurance, communication, and control plan are approved to define work package activities that will take place throughout the project lifetime.

The project activities planning consists of the setups, relationships, resource allocations, and estimated duration of activities for the timely completion of a current project. It simplifies the specific activities needed to fulfill the deliverables in the WBS as the individual units of work. The scope statement and stakeholder's requirements classify the resource estimation process.

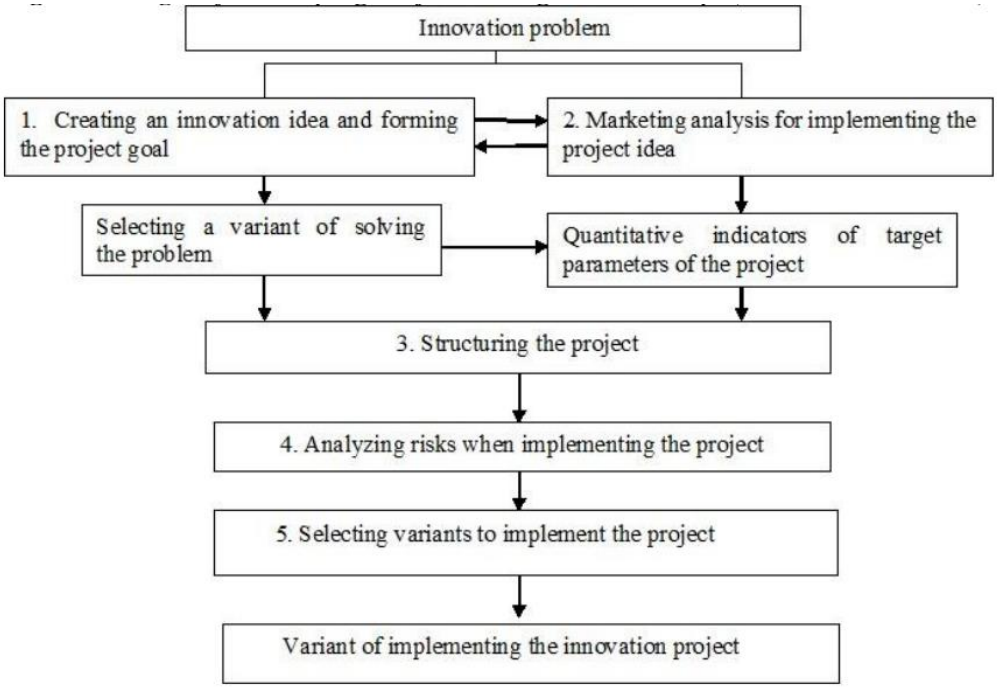


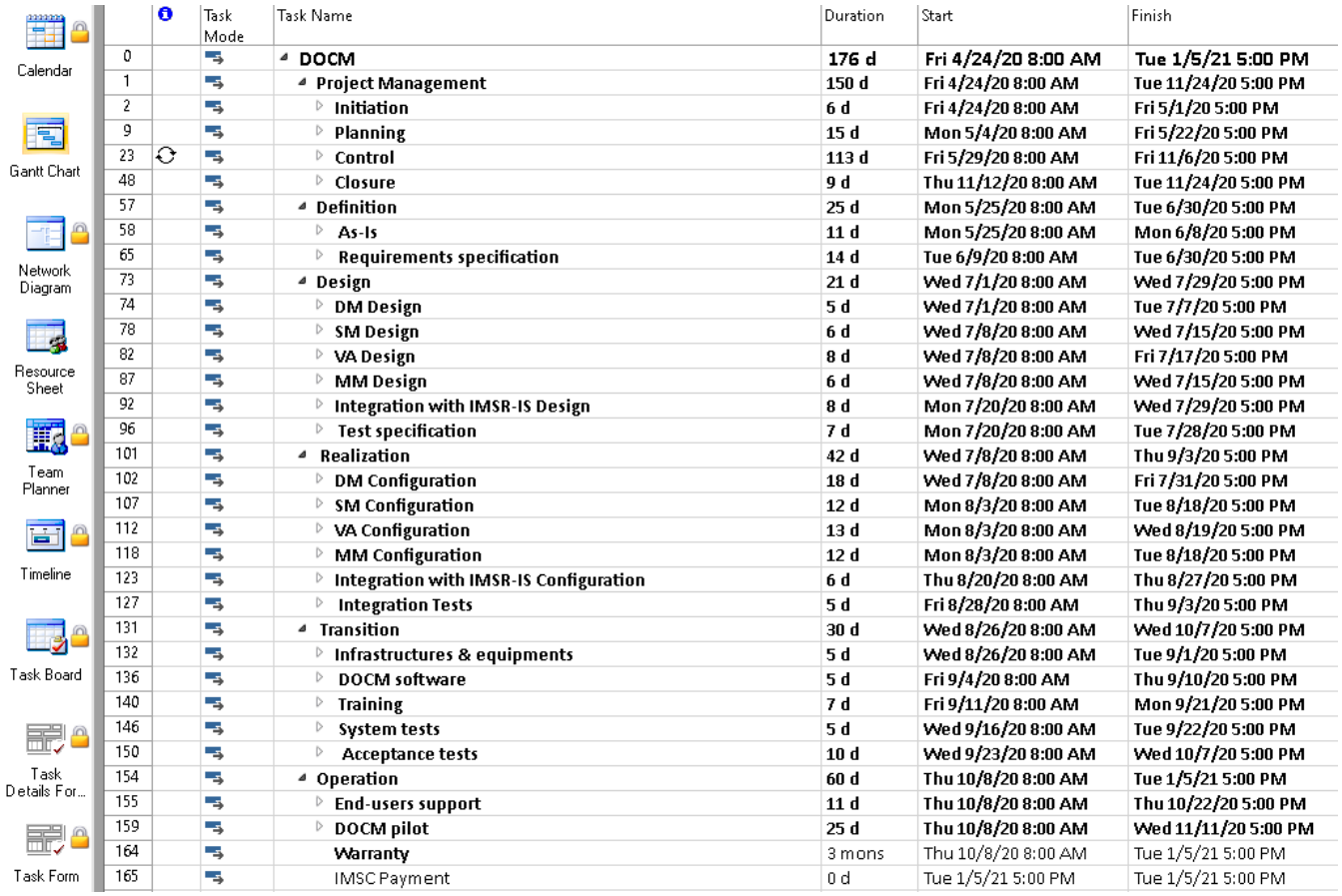
FIGURE 3. PM LIFECYCLE CONCEPT BY NECHAEVET AL.

Well-defined projects should be built with particular *Project Alignment* that includes WBS (Work Breakdown Structure), OBS (Organizational Breakdown Structure), RM (Responsibility Matrix),

Quality Assurance and Quality control plan, Risk Management by conducting resources, budget, and time schedules.

Figure 4. is one of our previous projects developed as a partial requirement. A free sample to explore IT projects lifecycle. The project is scheduled on *Microsoft Project* as it appears from the UI. The project itself consists of specific phases that include work packages and activities that meet the initial requirements. With the help of this example, we can define the structure of project phases. For a good project configuration, special activities must be included under the umbrella of Project Management, Definition, Design, Realization, Transition, and Operation. We may also realize the time duration of these steps.

Every project has specific activity phases and milestones. Once the expected milestone is approved, the next combination of processes is being executed. Almost until the end of the project particular members of the team keep control of the activity flow. It has been represented in the figure with a specific time duration. If any of the activities end with a delay and if the activity must be completed immediately before the next process can begin, the project has to be exceeded its budget adjustment for sure. That's not a result that the project manager and the project owner want to see. That's why arranging the project most realistically is necessary before the project get starts.



	Task Mode	Task Name	Duration	Start	Finish
0		**DOCM**	**176 d**	**Fri 4/24/20 8:00 AM**	**Tue 1/5/21 5:00 PM**
1		**Project Management**	**150 d**	**Fri 4/24/20 8:00 AM**	**Tue 11/24/20 5:00 PM**
2		**Initiation**	**6 d**	**Fri 4/24/20 8:00 AM**	**Fri 5/1/20 5:00 PM**
9		**Planning**	**15 d**	**Mon 5/4/20 8:00 AM**	**Fri 5/22/20 5:00 PM**
23		**Control**	**113 d**	**Fri 5/29/20 8:00 AM**	**Fri 11/6/20 5:00 PM**
48		**Closure**	**9 d**	**Thu 11/12/20 8:00 AM**	**Tue 11/24/20 5:00 PM**
57		**Definition**	**25 d**	**Mon 5/25/20 8:00 AM**	**Tue 6/30/20 5:00 PM**
58		**As-Is**	**11 d**	**Mon 5/25/20 8:00 AM**	**Mon 6/8/20 5:00 PM**
65		**Requirements specification**	**14 d**	**Tue 6/9/20 8:00 AM**	**Tue 6/30/20 5:00 PM**
73		**Design**	**21 d**	**Wed 7/1/20 8:00 AM**	**Wed 7/29/20 5:00 PM**
74		**DM Design**	**5 d**	**Wed 7/1/20 8:00 AM**	**Tue 7/7/20 5:00 PM**
78		**SM Design**	**6 d**	**Wed 7/8/20 8:00 AM**	**Wed 7/15/20 5:00 PM**
82		**VA Design**	**8 d**	**Wed 7/8/20 8:00 AM**	**Fri 7/17/20 5:00 PM**
87		**MM Design**	**6 d**	**Wed 7/8/20 8:00 AM**	**Wed 7/15/20 5:00 PM**
92		**Integration with IMSR-IS Design**	**8 d**	**Mon 7/20/20 8:00 AM**	**Wed 7/29/20 5:00 PM**
96		**Test specification**	**7 d**	**Mon 7/20/20 8:00 AM**	**Tue 7/28/20 5:00 PM**
101		**Realization**	**42 d**	**Wed 7/8/20 8:00 AM**	**Thu 9/3/20 5:00 PM**
102		**DM Configuration**	**18 d**	**Wed 7/8/20 8:00 AM**	**Fri 7/31/20 5:00 PM**
107		**SM Configuration**	**12 d**	**Mon 8/3/20 8:00 AM**	**Tue 8/18/20 5:00 PM**
112		**VA Configuration**	**13 d**	**Mon 8/3/20 8:00 AM**	**Wed 8/19/20 5:00 PM**
118		**MM Configuration**	**12 d**	**Mon 8/3/20 8:00 AM**	**Tue 8/18/20 5:00 PM**
123		**Integration with IMSR-IS Configuration**	**6 d**	**Thu 8/20/20 8:00 AM**	**Thu 8/27/20 5:00 PM**
127		**Integration Tests**	**5 d**	**Fri 8/28/20 8:00 AM**	**Thu 9/3/20 5:00 PM**
131		**Transition**	**30 d**	**Wed 8/26/20 8:00 AM**	**Wed 10/7/20 5:00 PM**
132		**Infrastructures & equipments**	**5 d**	**Wed 8/26/20 8:00 AM**	**Tue 9/1/20 5:00 PM**
136		**DOCM software**	**5 d**	**Fri 9/4/20 8:00 AM**	**Thu 9/10/20 5:00 PM**
140		**Training**	**7 d**	**Fri 9/11/20 8:00 AM**	**Mon 9/21/20 5:00 PM**
146		**System tests**	**5 d**	**Wed 9/16/20 8:00 AM**	**Tue 9/22/20 5:00 PM**
150		**Acceptance tests**	**10 d**	**Wed 9/23/20 8:00 AM**	**Wed 10/7/20 5:00 PM**
154		**Operation**	**60 d**	**Thu 10/8/20 8:00 AM**	**Tue 1/5/21 5:00 PM**
155		**End-users support**	**11 d**	**Thu 10/8/20 8:00 AM**	**Thu 10/22/20 5:00 PM**
159		**DOCM pilot**	**25 d**	**Thu 10/8/20 8:00 AM**	**Wed 11/11/20 5:00 PM**
164		**Warranty**	3 mons	Thu 10/8/20 8:00 AM	Tue 1/5/21 5:00 PM
165		IMSC Payment	0 d	Tue 1/5/21 5:00 PM	Tue 1/5/21 5:00 PM

FIGURE 4. EXAMPLE OF SOFTWARE DEVELOPMENT PROJECT

1.3 SPECIFIC OBJECTIVES

The main objective of the research is to develop a highly accurate Artificial Neural Networks model for use in the field of Software Effort Estimation. The variables that are arranged to achieve this target, have been analyzed and compared to portray this study as a particular approach in the area.

Following research questions have been characterized:

- What are the general and specific reasons causing inadequate project estimation?

  To find an answer to this question, I will help to find the solutions for dedicating model variables and processing specialized ANN architecture for development.

- Why are early-stage project estimates rarely accurate?

  It is almost the most important question of the Theoretical part to be responded to, which defines the reasons table of inaccuracy scale regarding the previous analytical statistics.

- What major roles does Artificial Intelligence may play to improve the efficiency of project performance?

  We have already remarked on how AI implementations compromise and bring value into the industry. The improvements in relations between business and consumer is a key point to increase the reputation scales and to rise revenue streams up.

- How ANNs methodologies can be implemented to predict the future effort of the project by producing reliable results through the quality of the acknowledged information?

  Collected datasets may help to predict the effort of future projects with aid of ANN applications. Those applications and models provide a quite high accuracy level in early-stage project forecasts.

1.4 THESIS ORGANIZATION

This thesis formally is combining Introduction, Analytical and Practical parts, Conclusion, Bibliography, and Appendices. During these steps, it's aimed to find answers to the cause of poor effort estimation.

The thesis work mainly consists of Theoretical and Practical parts; the first part includes special divisions: a general overview, traditional and modern initiatives, case investigation questions, impacts of AI in the industry, and proposed model applications. This technical section unites the main historical background of SEE, field inspection related to the particular questionnaire, ANNs'

practices in the Project Management area to achieve top success with bringing more value, and model development suggestions which are having high accuracy in effort prediction. Currently, this part includes 5 chapters and 16 sub-chapters.

The Practical side composes theory analyses, proposed model description, data determination and collection, model evaluation, conclusion, and future work. It was conducted with 5 chapters, and 6 dedicated sub-chapters to capture these sections with describing identification, analysis, and validation phases of the suggested model.

2. LITERATURE REVIEW

During the literature research, the paper will be created by evaluating and comparing the impacts of Artificial intelligence on Software Development projects, the predictive role of ANNs in terms of forecasting with the necessary phases, and the models planned to provide the appropriate knowledge base for completion.

As we discussed, Artificial Intelligence triggers descriptive technology by exercises of contemporary applications which make rooted changes in these specific fields of technology. The field of estimation also takes advantage of this development cycle. Hence, lots of forecasting techniques and methods have been used since now. To define the disciplines of estimation it's important to clear the authorities.

We belong to the technology and the use of modern techniques is a part of our lives. All purposes aim at solving the same task/operation with less effort, passionately encouraging. So, we can argue that every invention is somehow beyond this theory.

2.1 HISTORIOGRAPHY OF SOFTWARE EFFORT ESTIMATION

As remarked, Software Effort Estimation is capable get used by different techniques which we could separate into two dimensions as parametric and artificial-based predictions. The most famous parametric method which developed by Boehm that calls *COCOMO*. (Barry Boehm, Ricardo Valerdi, April 2005) For this section, I will try to explain the development, improvement, and compilation phases of this Constructive Cost Model as an example of one of the most competitive models in the industry.

2.1.1 EVOLUTION OF THE 1940'S TO THE 1970S (FOUNDATION LAYING)

Up to the models of *Adaline* and *Madaline* (1959), few attempts have been made to establish develop Neural Networks. Developers, mathematicians, and neurophysiologists such as McCulloch and W. Pitts (1943), D. Hebb (1949), N. Rochester (1950) – sought to discover and improve the maintenance of Artificial Neural Networks. The articles were mainly cover the work cycle of neurons, organization behaviour, etc. (Roberts, 2000)

In the early 1960s, Rosenblatt and Widrow & Hoff presented appealing papers containing learning procedures and pieces of training. Thus, perceptron learning algorithms and Gradient decent learning emerged. (Lacher, 2009) With the aid of these approaches, the idea of ANNs was started to expand its horizons.

However, still, it was an unanswered question that can we create a learning machine which may think? So, before computers began to program themselves, lots of assumptions came into the existence. Developed architectures and models brought new perspectives to the field until the late

1970s. In 1969 Minsky and Pappert proposed the paper introducing the error correction algorithms that discussed more later. In fact, the paper was quite extensive research until the invention of Unsupervised Networks in 1975.

2.1.2 EVOLUTION OF THE 1980'S TO THE PRESENT (PROGRESS REVIEW)

The National Academy of Sciences published the paper in 1982 embodying the idea, arguing that the use of bidirectional lines could create much more predictive models. The research was completed by John Hopfield to renew their interests in the field. A little passed, different models and networks were implemented and validated. That was the Fifth-Generation effort on Neural Networks by Japan in the US-Japan conference (Roberts, 2000). The first 4 generations used solid-state techniques as developing programming languages, and code compilations.

Although the research played a specific role in terms of network investigation, the newspaper of Business Day published the article with the name "Fifth Generation Became Japan's Lost Generation" on June 5, 1992.

The Japanese Government has announced that they are ready to sell the software to someone else after spending nearly $400 million on a project. US companies immediately began collaborating to develop the American computer industry. (Pollack, 1992)

During the next few years, new multi-layered ANNs were invented. One of these inventions was Backpropagation Neural Networks, led by David Rumelhart from Stanford's psychology department. As the networks often use hundreds or even thousands of iterations to learn from the error, the main difference with existing models was the number of hidden layers, units, and iterations.

After the 1990s new Neural Network applications were created in light of the previous invention. The technique used a learning range for each weight, adapted all the learning rates, and decreased the average error of estimating. The Backpropagation value will also be used in our model optimization as a training technique The model validation stage will cover this matter comprehensively during the next chapters of the research.

2.2 MODERN SOFTWARE EFFORT ESTIMATION TECHNIQUES

To predict the effort of the project, companies are fully independent in using any type of method. Some of them are well known and most used. Technics are usable to find the most accurate approximation of the project's effort, but not the exact! That may be to build the database instructions, project metrics, employee attentiveness, etc. We will see these components during future steps. So, to generalize we can say projects start to the phases of planning, estimating, and starting of execution, nothing can guarantee an exact time, budget, and/or resource alignments at all. These methods are only for facilitating thoughts and bringing the most realistic outputs.

At this stage, we will look into the known and most used techniques and methodologies in the development of Software projects. To develop the new project and/or to enhance the existed system needs to have extra attention for the perfect forecast.

The years we left behind were enough to come to common senses in project predictions. The environmental methodology could be defined as below:

- Classic Techniques:

- COCOMO (Data/knowledge base)
- Wideband Delphi (Team Brainstorming)
- Use Case Point, Function Point Analysis, Program Evaluation, and Review Technique (Parametric Estimation)

- Agile:

- Planning Poker (Team Brainstorming)
- T-shirt Sizing (AltexSoft, 2018)

In terms of competition, companies have to seek efficiency for developing projects without losing credibility. The owners of projects wish to see concrete results regarded the scheduled budget with the resources assigned on the specified date. Any lack of these 3 expectational valuations is potentially budget overrun and/or schedule delay. Every single day after the deadline is an extra expense and excessive effort. So, to avoid these scenarios, the main methodologies will be described and evaluated.

2.2.1 TRADITIONAL EXPERT JUDGMENT

Projects are always being scheduled based on the requirements list, equipment/stuff availability, and budget constructions. These estimates are purely expert-based and cannot always guarantee the highest degree of accuracy in the process lifecycle. The experimental background of the leader of management (managers) may surely be a considerable point in the forecast, however, projects – specifically projects of Software Development are always open to changes and risks during the execution.

These expert evaluation methods are most useful with small-capacity projects. Basically, experts can imagine and predict future efforts, but no one can control the unplanned activities. That's why these traditional approaches may cause high stability risks during implementation.

Field research shows that most organizations use these methods rather than constructive or Neural Network-based techniques which we will be talking about later on.

Planning Poker/Wide-band Delphi

Planning Poker

The Planning Poker (PP) (which is also known as Scrum Poker) is one of the traditional prediction techniques with using of poker probability forecast. This method of forecasting makes use of team members considering their assumptions. As a technique of Scrum (Neves, May 2017) the methodology can work properly unless the project has any predefined activity or unstable scenario which are the high contingency in especially Software Development projects. The task that wasn't kept in view during the estimation is a potential development risk. However, it's not enough just to be informed about the problem the purpose of specialists is to eliminate future unexpected risks.

The poor preparation of project scope or methodology of execution also may cause inadequate estimates. Therefore, believing and expecting 100 % accuracy from this method would be a fairy tale.

We may imagine a small team that is working on a particular task including certain activities, to explain the PP methodology as easily as it can. The members are predicting the estimated time and cost schedules individually. In other words, in this method, the effort analysts simultaneously are the roles of planned activities.

The manager comes up with the new project requirements and the team is just trying to define an estimated effort scale to conclude the work. Until the estimation stage, the work packages, project benefits and success criteria, scope identification, activity and resource alignments, potential risks, and more similar components of the project should already be readily available.

This operation is executed by developers during time-bound meeting sessions. It's not continuing regularly as a standard Scrum meeting. The meeting starts with giving special Scrum poker cards to the participants. The cards include different kinds of numbers (0; ½;1; 2; 3; 5; 8; 13; 20; etc.) and one break and one raise question options (within other 2 cards) (B.Neha, Jan 2021) As the following figure the work cycle of the estimation process is not difficult unless there is unreadiness in the project. So, this technique is fully able to work well within an agile methodology.

Principally, the team members are starting the estimate an effort based on the analyses of previous projects. This expert judgment method directly interacts with the professional autobiography of stuff; hence the number of sessions may rise based on complexity.

Briefly, the velocity of the team is a key component of this method which prevents possible future risks. These members are those who take over the responsibilities. So, they make every effort to keep on the best of terms by completing the duties and making smooth transitions.

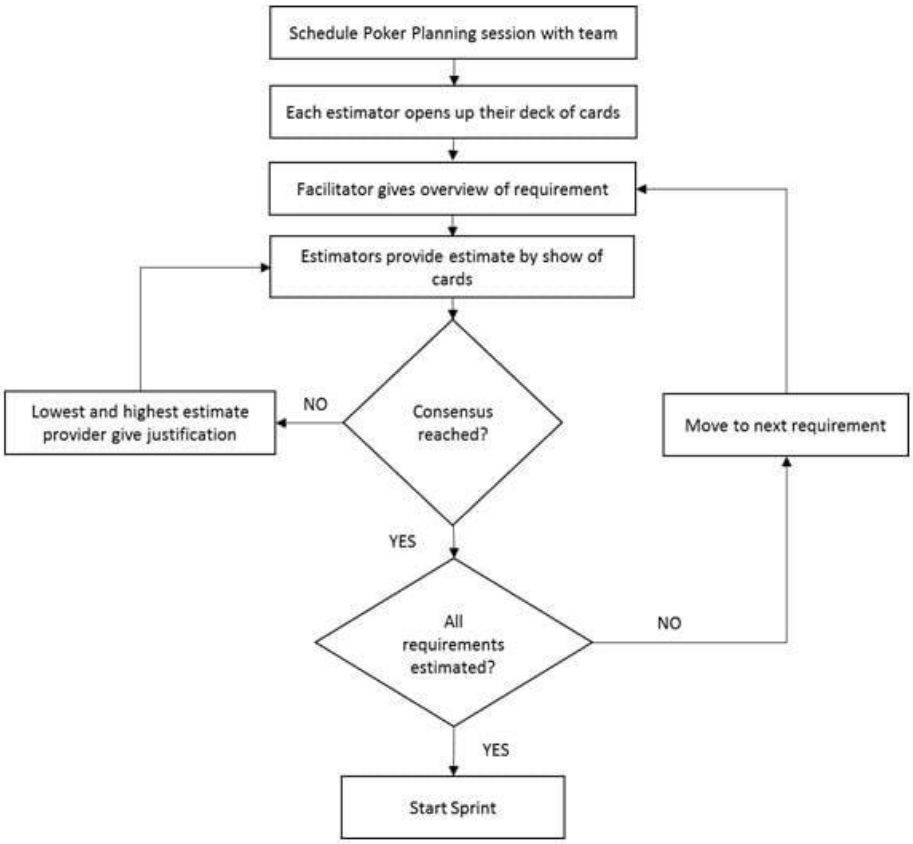


FIGURE 5. PLANNING POKER PROCESS CYCLE (B.NEHA, JAN 2021)

Wide-Band Delphi

The methodology of Delphi is the consists of implemented iterations. The process starts with the studying and investigating of the case with previous expert feedback. After the comparison, the first iteration begins with the most sensible estimate. The effort scale becomes narrow with the comments and ideas/thoughts of team experts and members.

There are also computerized and web-based Delphi Methods that aim to accelerate the work schedule of the participants and to automate the project's governance roles fully or partially. Since the activities of the project can be carried out and controlled within the specified software, the necessity to be in the same place is not an obligation which is the most beneficial side of this judgment method.

Test Case Enumeration-Based Estimation

As we mentioned earlier, Software Development accommodates a variety of unstable scenarios, it's not always possible to estimate and control future projects' trends.

Test Case Enumeration is one of the methods of defining and designing test cases of the project. For this, it's necessary to know the effort estimation to be used in test case estimation. The specific formulation can be used for this calculation.

As a sufficient number of cases and conditions can occur, estimating the time to be used in the testing phase may be disadvantageously time-consuming. (Kamala Ramasubramani Jayakumar, Alain Abran, 2013) As a traditional expert method, Test Case Enumeration isn't always able to produce the output with high accuracy level.

Organizations may use particular knowledge and experience bases to forecast planned projects. However, not all projects start up with the same resource packs and work for a team.

2.2.2 ADEQUATE ESTIMATION METHODS

Artificial Intelligence can collect, compile, analyze and even learn from existing bugs, as it is one of the most intellectual technological inventions ever. Minimizing the average error functions while paying attention to overfitting is the advantage of the developed models.

To talk about adequate estimation methods, we can mention LOADEST (Load Estimation Methods). The use of data censorship is the main factor for these methods. If one or more observations are used, data censorship will occur. Introducing the bias correction factors addressed is one way to reduce computational errors.

The LOADEST uses 3 different techniques (Kenny) during the forecast:

- Maximum Likelihood Estimation (MLE)
- Adjusted Maximum Likelihood Estimation (AMLE)
- Least Absolute Deviation (LAD)

The methods described above use different formulations to calculate the Misclassification Rates and Squared Errors. The methodology used for reducing time usage and increasing user satisfaction.

Use Case Points and Function Analysis

The projects which are being implemented Unified Modelling Language (UML) methodology are quite suitable to define Use Case Points (UCPs) analysis. As one of the main priorities of UML structure, the list of requirements should be defined which is almost UCP itself.

Based on the test scenarios and cases, this approach is used as an alternative for using points. The process shows the number of actors to be assigned for the activities. The term UAW (the Unadjusted actor weights) gives weights of members who have not yet operated. The actors are of 3 different types – simple, average, and complex. Since now, lots of organizational projects are handled with this method with valuable results.

The Unadjusted Use Case Weights (UUCW) is getting to be handled right after this stage. The formulation for this estimate is "*UUCP = UAW +UUCW"* which brings value AUCP (*Adjusted Use*

Case Points) after TCF (*Technical Complexity Factor*) and EF (*Environment Factor*) values. Use cases are correlated with corresponded weights. Therefore, the number of operations is the majority of this analysis. These transactional operations could be determined as; Interacting maximum 3 operations that specified equal to the weight of 5, interacting maximum 7 operations with equal to the weight of 10, interacting more than 7 operations equalled to the weight of 15. (Cristian A. Remón, Pablo Thomas, July 2014)

The field research shows that although this methodology has system limitations, it still has many beneficial aspects. By limitations, I just meant - the lack of accuracy in defined requirements, nonexistence of particular way of UCPs, misunderstanding on complicated flows that add complexity, and so on. In terms of advantages, we can arrange the list as below:

- It's useful in planning activities of projects with defined dates of milestones
- UCP ensures a fundamental baseline for cost and time estimations
- It provides great communication with the stakeholders
- Case Points might be the spectacular start, in terms of design and end-to-end testing
- This methodology specifies the actors engaged and the needs from the product under the very good UCP coverage
- Use cases are real requirements (Anita, 2019)

2.3 INSPIRATION AND BRIEF HISTORICAL CONTEXT OF ANNS

As a priority of our research, during the sub-chapter, we'll be discovering the biological fundamentals and inspiration, and historical background of Artificial Neural Networks which will be extremely helpful to understand the architectural configurations of different Neural Networks. In another word, I will try to clarify how the human neuron system came into existence and how great the human brain is!

Biologically, our brains consist of a hundred billion neurons. All remain, stay connected with other neurons at the same time. The relationship of each neuron's connection is handled by the *Axons* (that we will be calling a weight later). These neurons are connected by thousands of links.

To begin the operation, the input must be received to initiate the process. Then the veins of Dendrites came into the operation. These are signals that provide the initial data for us, while the specified neurons receive electrochemical inputs from *Dendrites*. If the sum of those input signals is strong enough, neuron activation occurs, and the signal is transferred to another neuron by Axon. Attached neurons fir only after all the connections are made. The important note is that the total amount of signals should exceed a certain level to produce a valid output. (Caroline Clabaugh, Dave Myszewski, and Jimmy Pang, 2020) As I mentioned with the power of our brain this operation takes place just in a moment from the number of single initiating units. This is the general form in which modern Artificial Neural architectures are shaped and operated. So, basically. learning the recently collected data is a natural process on our side that triggered to impact the AI during last years with similar model inventions.

Since the unknown patterns have not been created in our brains yet, conditional operations can give an adequate shape to our decisions with the only help of the human intelligence power. For example, we know very well what the difference between green and blue is. However, when it comes to the color in between dark green and light blue, the detection is much more difficult, and identifying the right color with the most confidential accuracy is already a new challenge.

Principally our natural neuron system can't provide an output without any data being collected which ensures signals through the input (known data) and hidden layers (expectations). By allowing brain speed, the cycle of stages can be retried thousands of times. During the operation, every next assumption is a potential output that was found with the neuron of rotations of connected weights. This operation is happening almost in the hundredth of a second in the light of our biological power. So, finally, the resulting output is an answer with a greater degree of predictive accuracy.

The term Neural Networks came to the field of AI in 1943, with the common intention of McCulloch and Walter Pitts with defining neural basics. (Wook Joo Park, Jun-Beom Park, Oct 2018) The demonstration of this invention is based on the neuron system of the human brain, which allows us to make highly accurate decisions. The methodology completely takes into account the biological anatomy hierarchy.

The new idea emerged in 1949 with a book titled *The Organization of Behaviour* by Donald Hebb, as a result of industrial investigations conducted through different research and articles between the years of 1932-1945. Although many years have passed since then, this work may still be sufficient in terms of behaviour to a synaptic organization for ANNs. (Brown, 2020) This book has been dedicated by many authors and researchers as one of the masterpieces in *Cognitive Neuroscience*. So, D. Hebb's initiative in the history of Artificial Neural Networks could have been identified as the first framework.

Unique improvements of Neural Networks started to spread after the 50s. The models of *Adaline (Adaptive Linear Element)* and *Madaline* were developed in late 1959. The technique of *Adaline* consists of one and only one layer containing inputs, weights, vectors of input and weight, and output of the model. After the first enterprise, the advanced version of the previous model was applied. The *Madelina* comes from Many-Adeline (Wikipedia, Nov, 2020) which contains three different layers instead of the first model architecture. In the light of the development of these models, special formulation methods and constructive structure have brought a change in environmental perspective to the future perspective of ANN.

At the beginning of the 60s, the new learning methodology developed by Widrow and Hoff which was combining input signals collection inside of the main neuron. The weights also were adjusted within the Neural system. The process belonging to the regulated weight might bring positive or negative outputs. (Widrow, Hoff , 1962) As seen in figure 6. the accurate interrelations between input and output neurons (which might consist of a maximum of 5 input elements) brought this architectural design into existence as an application by Mattson in the late 60s. The application suggested managing the noisy geometric patterns for disruption of the adaptively sampled data system.

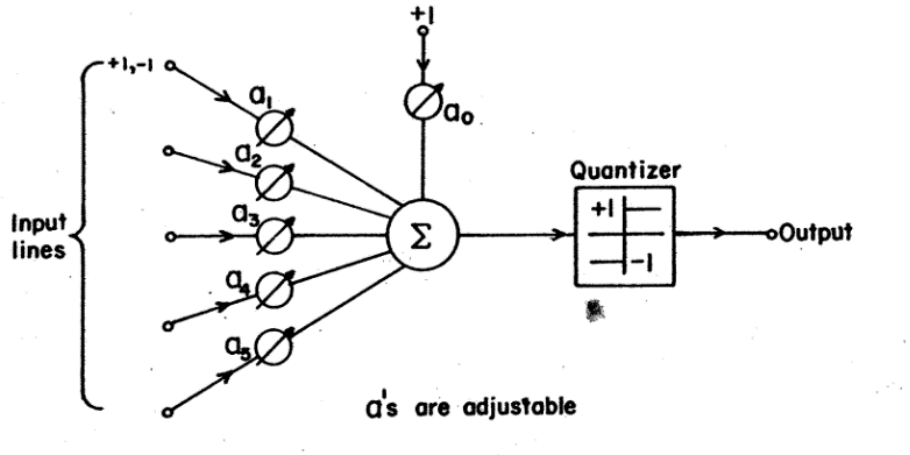


FIGURE 6. THE ARCHITECTURE OF THE PROPOSED NEURON (WIDROW, HOFF , 1962)

By the following years, new and unique approaches were proposed to improve the broaden the horizons of ANNs. The first innovative breakthrough came to the field by John von Neumann, almost one of the most reformist representatives of the first concepts of Machine Intelligence (Mühlenbein, Jan 2006) This historical phase of Neural Networks can be characterized as the period of composing and development of designed electronic computers. All similar initiatives aimed to find ways to push the limits of Artificial Intelligence from the perspective of the human brain.

In 1972 the field of ANNs become acquainted with the term of Kohenen Neural Networks (KNNs) that was invented by Kohenen with the new target direction of Artificial Neuron Systems. KNNs were demonstrated with the basics of ANNs which used unsupervised learning algorithms with self-organizing neural networks. (Anderson, 1999) From the view of the technical environment, this property has an opportunity to adapt unknown input neurons which means the most indigenous way of learning from collected data. As we explained in the previous subsections how this process takes place on our neuron system, I will continue with defining the KNNs architectural design below.

Figure 7. describes instructions of KNNs, with 3 inputs and 9 – so-called, Kohenen neurons. The elements of the input layer connect with each of the other neurons to ensure the self-organizing estimation technique. The process starts with connections of given inputs with the engaged Kohenen neurons. These interrelations proceed to find the proper output with corresponded weights. It lets the system define a much more adequate node in every next loop. The output of the process is the winning neuron/path which states between -1 and 1.

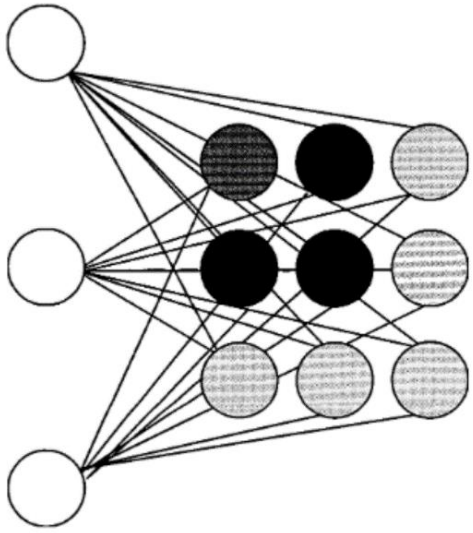


FIGURE 7. ARCHITECTURE OF KOHENEN NEURAL NETWORKS (ANDERSON, 1999)

2.4 IMPLEMENTATIONS OF ARTIFICIAL NEURAL NETWORKS' METHODOLOGIES IN SEE

After mentioned improvements started to be observed, developers decide to bring Artificial Neural Networks' techniques to the area of Software Effort Estimation.

Some of those networks were validated successfully, while the other ones were completed with a high degree of errors rate. During the next chapters, we will be considering those Neural Networks with their advantages and disadvantages. The structure of those networks is quite different which may adjust with totally different scenarios.

2.5 MODERN ANN'S ARCHITECTURES USED IN SOFTWARE EFFORT ESTIMATION

During this paragraph, I will try to discuss modern Artificial Neural Network architectures, with also some visual examples. Those figures will show how the neurons integrate each other and how the values are suitable for making an estimate. The methodology is pretty much the same for all approaches, but equations. The neural system formulates this way exactly with an input or inputs those weights are given significantly by the flow.

Theoretically, the action does not seem difficult as it gathers a certain mind from training (related to data usage) and the system produces a model output after taking the initial prediction role. However, a large number of architectural and technical variants were logically used to bring Neural Networks to today's power. We will talk about them one by one in the next subsections.

As mentioned before, one of the most used methods in the field is COCOCMO. Then it ensures the Source Lines if Code and Function Points as Sizing Method. The user needs to indicate special parameters of a project like Software Scale Drivers, Software Cost Drivers, Personnel, and Platform

requirements. After adding the unadjusted function points the platform estimates Effort, Schedule, and Cost statuses.

The latest papers and articles are used to demand the recent specifications of ANNs in the modern industry. The differences in work cycles of these architectures are particular equations. They are components are governing these interrelationships between layers of neurons.

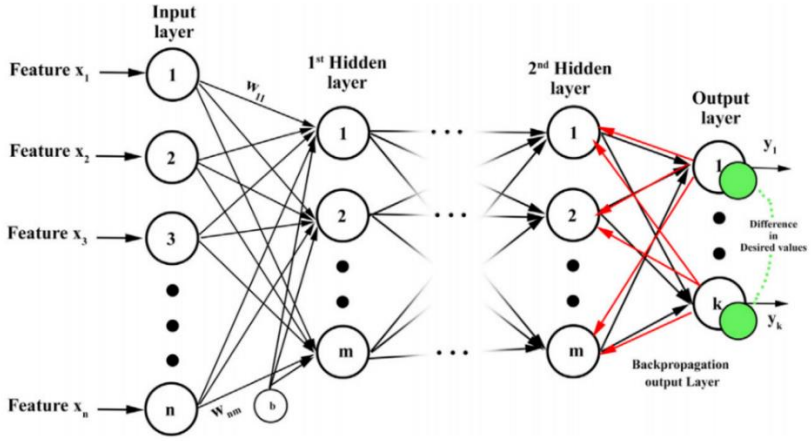


FIGURE 8. ARTIFICIAL NNS WITH BACKPROPAGATION

2.5.1 WAVELET NEURAL NETWORKS (MWFWNN)

To talk about Wavelet Neural Networks (WNNs), we must first take a look at Wavelet Analysis (Wavelet Theory). It's the theory that gets generated based on signal processing, which was recently implemented to the communication systems, signal/image analysis, etc. In this aspect, we can specify some similar sides of this analysis with the Fourier analysis as well. While the functional base is being determined as a common property of both techniques, WNNs use function analysis through the wavelets that are generated by the *mother wavelet*. (Daniel T.L. LEE and Akio Yamamoto, Dec 1994)

The term Wavelet Neural Networks came into the industry with the proposal of A. Zapranis & Refenes in 1999

The different design and execution phases can be defined as below:

- Defining mother wavelet and evaluating the specified value
- Determining wavelet signals in the stage of wavelet transformation
- Finding integer values for normalization the discrete wavelet transforms
- Evaluating the outcomes connected to wavelets with the weights

So, when Wavelet Analysis is being combined with Sigmoidal Neural Networks (SNNs), the Wavelet Neural Networks come out. The methodology was developed on 3 layers which consist of input, hidden, and output neurons. In figure 9, we see connections and specified weights were also indicated to describe the wavelet interactions. The Wavelons are units in the hidden layer. The formulation is detected as follows: φ a, b (x) = |α| −1/2φ (x − a b) (P.Kumar, H.S.Behera, A.Kumari, J.Nayak, and B.Naik, july 27, 2020) (Kun Zhang and Jian-bo Fang, Nov 2014) The final result (output) is estimating by the collectiveness of modified weights regarding the mentioned algorithm.

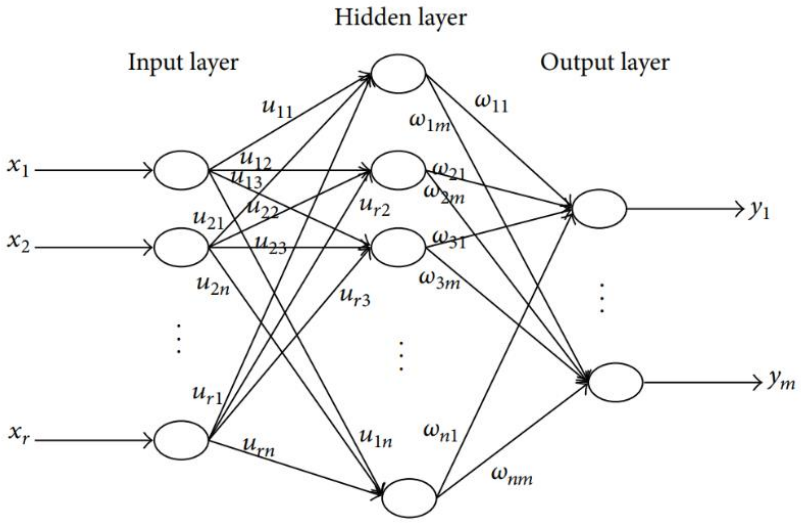


FIGURE 9. ARCHITECTURE OF WAVELET NETWORKS (P.KUMAR, H.S.BEHERA, A.KUMARI, J.NAYAK, AND B.NAIK, JULY 27, 2020)

2.5.2 GENERALIZED REGRESSION NEURAL NETWORKS (GRNN)…

As a much similar network of Feed Forward Neural Networks, Generalized Networks was invented and presented in 1991. The most distinct phase of this network is training. With GRNN, data simply needs to go further with a single goal, rather than using backward steps to find and fix the error.

The network is not fully independent to find and avoid physically impossible outcomes. With the data stored the connections occur and the training starts to learn in one way. The weights carry major attributes to every next layer until the output. (Beyza U. Mehmet K. H.Kerem Cigizoglu, 2008)

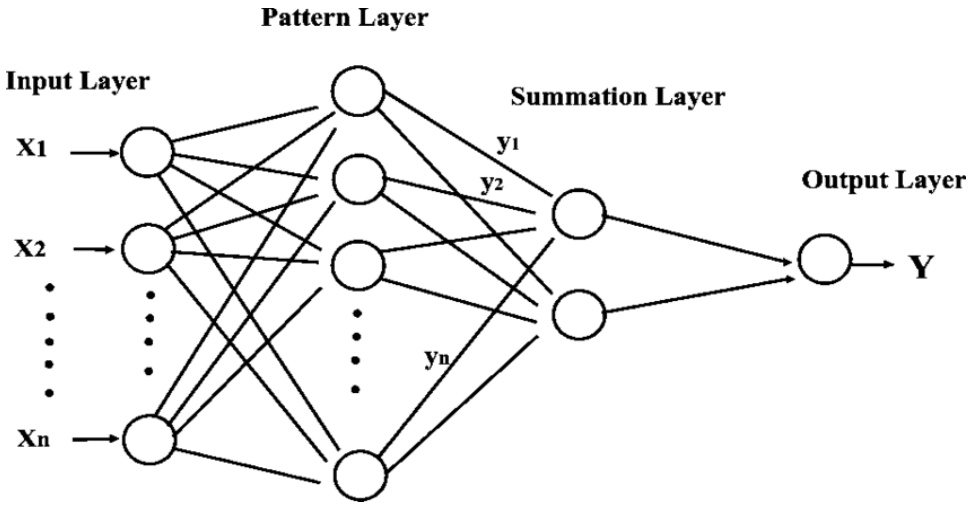


FIGURE 10. GENERAL REGRESSION NEURAL NETWORKS (BEYZA U. MEHMET K. H.KEREM CIGIZOGLU, 2008)

In GRNN, the activation function in hidden units calls the Gaussian kernels. The networks analyze and evaluate every single pattern and attribute and don't use the back propagation methodology. The user may reduce the time-consuming during the training phase with GRNN. It's the most advantageous side of networks of General Regression. Since the development date, the GRNN used for predictions, fitting, and regression issues as its regression-based neural networks. (Ahmad Jobran Al-Mahasneh, Sreenatha G. Anavatti and Matthew A. Garratt, 2018)

2.5.3 FUNCTIONAL LINK ARTIFICIAL NEURAL NETWORKS (FLANN)

It is known that Functional Connectivity Neural Networks are mostly used for noise estimation systems/platforms. To make things clear, I will introduce some applied models and important features of noise estimation along with our research too.

Looking back, the proposed equations were developed and approved in late 1952 and improved in 1968. Only in 1972, the method and model of noise estimation officially established. (TRID, May 1976) Today already, noise estimation has particular applications and models for predicting the voice of human speeches (with an average speed of 60dBA) in a high level of accuracy. The automatic voice estimates on special internet browsers or websites are just a few examples based on this theory. Typically, the methodology is the same as learning from the collected data. After the session of training (the time duration of this stage is changeable corresponding to an amount of data) model can predict the different interviews, speeches, and/or dialogues between people.

If we talk about the less computation cost and implementation software Functional Link Artificial Neural Networks is one of the networks that have to be mentioned. The Legendre Neural Networks are also one in the same classification. FLANN generates nonlinear decision boundaries, to solve complex problems and fix the errors. There are several models of FLANN for noise prediction as well. The accuracy level of these models has been authorized and accepted. At the training stage, the network uses a specific formulation with the aid of weights. Finally, we can say that FLANN is

one of the most useful networks for developers to predict the noise condition with an average squared error function. Thus, in figure 11. we can monitor and analyze the architecture of Functional Link Neural Networks. (Santosh K.N. and Debi P.T., Jun 2011)

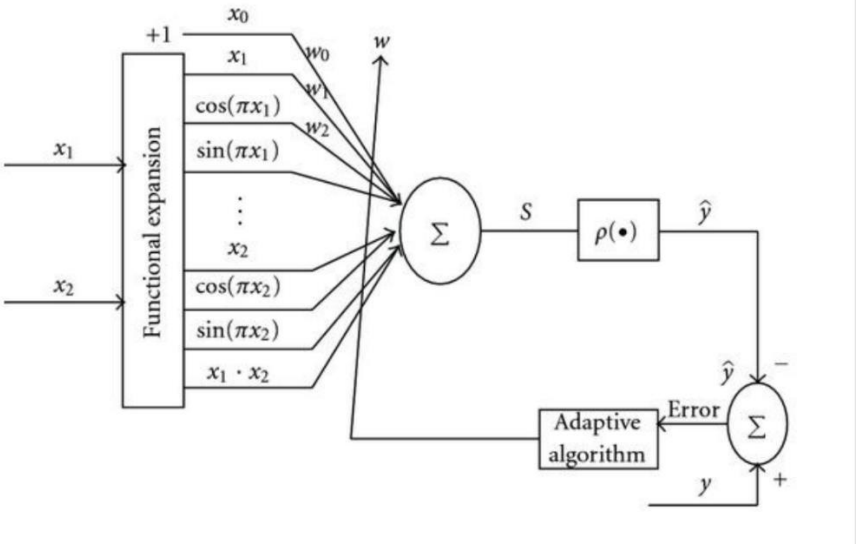


FIGURE 11. FUNCTIONAL LINK ARTIFICIAL NEURAL NETWORKS (SANTOSH K.N. AND DEBI P.T., JUN 2011)

The process starts with initializing the inputs with distance and sound power level. After the weighting parameters are defined, the functional block calculates delivered information while making different hidden functional blocks with desired variables. Then the network calculates the error of the system with desired and predicted results. Momentum parameter counting together with time index for updating the weights. Afterward, if the error is within the limitations the process stops. Otherwise, the program returns to the initialization phase.

2.5.4 SPIKING NEURAL NETWORKS (SNN)

Artificial Spiking Neural Networks accepted as 3rd generation of ANNs. Biologically neurons spike one to another right after receiving the signal. The number of signals increases with every connection. The spiking process continues until the desired outcome is reached.

From that, SNNs were evaluated and structured. With the synaptic connections, the network uses spikes to define weights for computation:

$$\tau_m \frac{\partial u}{\partial t} = u(t) - u_r + RI(t)$$
$$L \frac{\partial u}{\partial t} = -\frac{1}{R}(u(t) - u_r) + I(t)$$

The output is getting calculated mathematically in a way ahead. The formulation includes a constant time of membrane, resistance of membrane, spike reset, and membrane potential voltage. As part of Deep Learning Neural Networks, SNN is a multi-layered neural network. SNN is useful for seeing and solving complex problems with complicated relationships of spikes (nodes). As shown in the next figure, the hierarchy of networks consists of an input (index: i), a hidden (index: h), and an output layer (index: j). Information flows into the output layers to get the most accurate value. When the network claims the target, it completes the process and spikes stop their interactions. (P.Kumar, H.S.Behera, A.Kumari, J.Nayak, and B.Naik, july 27, 2020)

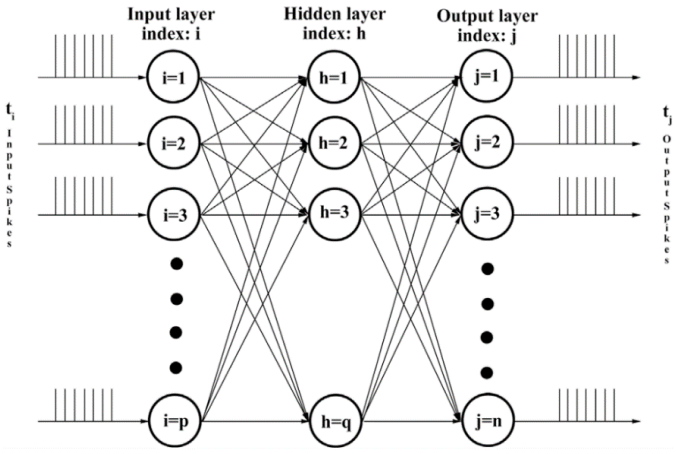


FIGURE 12. ARCHITECTURE OF SPIKING NEURAL NETWORKS (P.KUMAR, H.S.BEHERA, A.KUMARI, J.NAYAK, AND B.NAIK, JULY 27, 2020)

2.6 SOME OF THE PROPOSED MODEL APPLICATIONS

The work is schemed to achieve the attention of society with the collectiveness of important and beneficial points of remarked fields in a much straightforward and comprehensible way. Most pieces of training and evaluation results show that selected ANN models are satisfactory for modeling alternatives. (Xiao-Hua Jin, Guomin Zhang, July, 2011)

Applications can find more accurate outputs. However, it's not always possible to estimate the results, as there are so many things that may affect the nature of the project. Developed platforms are most effective with data from the same source. So, the tool can test the known data used in the training session. It is also important to determine the division of percentage correctly.

While not every company is overly intent on using forecasting techniques, IT organizations directly seek the most accurate forecast values. The usage of these model applications is one of the major steps to take while building the phases of Project Management activities.

The estimation models are mostly consisting of all necessary cost/time factors as well as expertise-based techniques that can be directly applied for Globally Distributed Environment projects. However, it's mandatory to have a wide experience and knowledge of GSD. (Manuel El Bajta, Ali Idri, Joaquin Nicolas Ros, Jose L.F.A, and Ambrosio T., April, 2017)

2.6.1 "NOTICE" - INTEGRATION OF VARIOUS TYPES OF DATABASES FOR SEE

As primary datasets (used in training) are capturing the major quality factors in the forecasts, individuals feel vulnerable to deciding on a special model to predict an effort on the formal project. Therefore, to achieve reliable outcomes, it's better than the guaranteed system already knowing the traditional cycle of particular operations based on certain IT infrastructure.

Considering the size of software development projects today, the difficulties are being encountered during the governance of projects that increasing day by day. There are a few project managements tools in the industry to facilitate the activity flowchart of projects.

This work aims to synchronize 2 different, at the same time interrelated databases to reach an estimate of the total effort of projects. Shortly, to increase customer satisfaction and ensure high-quality project governance, the system was integrated with 2 different platforms in that specific company. The part of managing of Business-Consumer relationship; in other words, receiving customer requests, analyzing measurements, … were governed by the CA_Service Desk Manager. Conversely, JIRA used to increase efficiency in Project Management activities with planning tasks, demonstrating schedules, assigning resources, etc. (Kazım Kıvanç Eren, İlknur Gür Nalçacı, Burak Bilge, 10/09/2018)

The customer need is the only thing that can trigger the best and may potentially be the biggest motivation for projects to start. Today, modern organizations mainly use elementarily reputation-based software programs, to increase customer satisfaction and reduce the amount of time to resolve each offer. Generally, what the consumer needs are getting quick feedback on their inquiries. Then, the random agreement can be arranged after the result analysis.

I created a simple Bizagi model (Figure 4) which simply explicates the formal admission work cycle of effort estimation queries. Generally, the platform has a potency for several activities as below:

- Starting a new customer case
- Analyzing of queries by admission stuff
- Estimating the analysis, software development, and testing phases
- Closing of the case if a consumer doesn't agree
- Documenting the certificate after the request for change if the consumer agrees with the agreement (Kazım Kıvanç Eren, İlknur Gür Nalçacı, Burak Bilge, 10/09/2018)

2.6.2 "PROXY"- PREDICTING PERSONAL SOFTWARE EFFORT IN THE FIELD OF BANKING

In 2000, Humphrey introduced the term PSP (Personal Software Process) to the industry (Humphrey, Nov, 2000) that was defined to describe the majority of individual responsibility and authority of developers within Software Development Project. The framework keeps individual discipline and ethics under its wings. The PSP may streamline engineering efforts while the Team Software Process (TSP) is processed. In the upshot, the goal is the same – to complete the planned work at the time set within the desired budget. The methodology was and is available to use for academic as well as industrial purposes. For having at least, a small theoretical view of the process life cycle we can separate activities as below:

- Writing planned requirements for declaring the scope and remark achievements
- Running the test integrations in order to conclude work packages with a pilot phase
- Defining activity phases and processes that we call Work Breakdown Structures
- Repairing future risks and defects with risk management and compulsory assessment

Briefly, this PROXY-based approach defines to estimate the effort for testing phases of projects in the sector of banking. It develops the role model for predicting the functional testing effort by IT professionals in the private sector bank.

Back the history, the staff of Denver Airport was aimed at developing an automatic baggage system in the early 90s. The cost of the delay resulting from this accidental case has been calculated to be around 1million dollars per day, 340million dollars in total. The estimates of the effort of testing stages are one of the main functionalities of effort forecast in Software Development Projects. The project, which was planned to be completed on the 31st of October of 1993, ended unfortunately on the 28th of February 1993. (Kahveci, 2017)

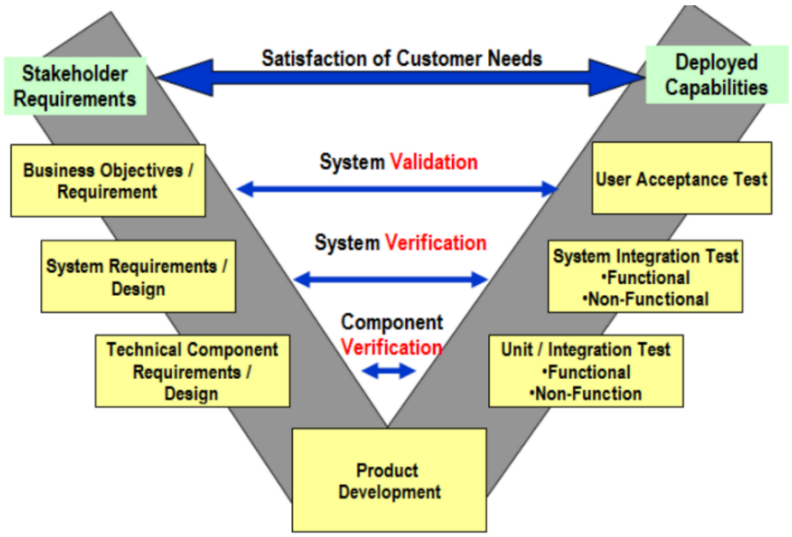


FIGURE 13. THE "V" MODEL APPLIED INSIDE OF THE BANK (KAHVECI, 2017)

Boundary-based software effort estimation

The different approach in the field is the model for estimating the software effort with boundary time frames. As an output system identify the person/month effort with the investigation of given data.

In Figure 14. we may see the activity flowchart for a project designed in Bizagi. The process starts with an application request. After initial analysis, coding and test effort are predicted accordingly. Then, if the client accepts the results, the documentation process is starting to be initiated.

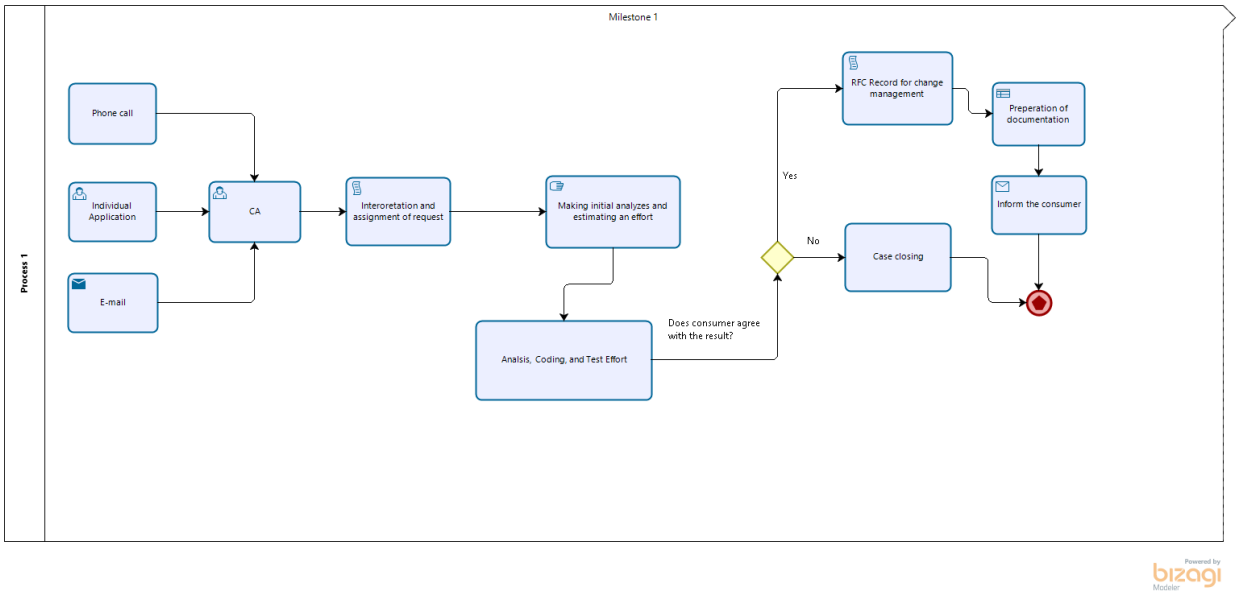


FIGURE 14. EFFORT ESTIMATION REQUEST ADMISSION

At this point, I will be defining a small entrance for JIRA which is the favorable and one of the advantageous platforms for arranging the work packages, resource alignments, time schedules, and activity flowcharts of projects.

There are several types of JIRA products with various features, which are helping users to ensure an accurate and comprehensive timetable with the associated characteristics. Those are divided into 3 different purposes for Business, Software, and Service projects. Basically, the features include usability for all types of users - the legal templates for HR and other business teams, a customizable portal for users to change their interfaces as they wish, an authoritative layout that allows consumer access permanently, SLAs, and Agile boards. However, the restrictions are also possible for users as permissions of admission office for creating a project on installed product. (ATLASSIAN, Jan 27, 2021)

Considering the target of our research, I will continue with clarification of the platform in the light of Software Development Projects. Although, the rest of the products may also contain the same or similar properties, defining the proper lineaments will be the straightest step.

The SP section has 4 main dimensions, Project, Issue, Board levels, and JIRA Software gadgets. The levels themselves are divided into activity stages. Creating, viewing, interpreting, migrating, developing of view, comment, and transition are just a few of these benefits. Figure 5 shows the

anatomy of the workflow (RADIGAN, Oct 16, 2013) which consists of statuses (where), transitions (what), assignees (who), and resolutions (why). The purpose of this platform is to facilitate the effort of the user by performing reliable activity diagrams. The results of coding and review of the code statements are managed under the authority of the QA manager. Sometimes, stakeholders want to see the realistic outputs instead of analysis documentations with a long amount of pages.

The platform itself can control the resources along to transition, make sure the transitions are beyond the milestones, perform the extra preventions on issues without the creation of another type of activity status. Besides all, it should always be remembered that the flowchart is just the beginning of everything around a project. Therefore, listening to the consumer, having necessary empathy, and educating them on unknown issues are the major fundamental base of stretch.

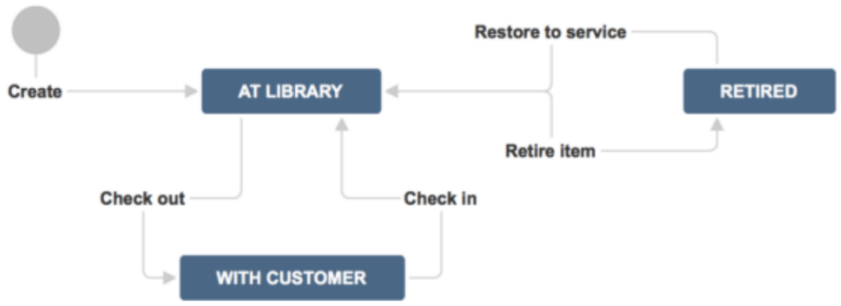


FIGURE 15. JIRA WORKFLOW

The tools described above are 2 main tools (which assign to also 2 different DBs systems for collecting datasets) used to govern by this specified organization for defining tasks and then executing the processes. As per, consumer requests these databases normally are in the dynamic circle.

Generally, the proposed model (NOTICE) synchronizes those databases to generate a table of random variables to predict an effort of projects. Thus, to combine CA and JIRA, the NOTICE database copies data collections while upgrading variables. The performed Windows service consubstantiates three different tables on a board named JIRA_CA. The effort spent on this procedure takes about 5-6 hours to complete the operations.

The data sets used in this work are based on the organizational archive. Other collections are described in Table 1. NOTICE was designed to keep track of all activities from start to finish.

In the general aspect, this suggested model aims to shorten the amount of time to analyze between consumer demands and the admission stage. Such approaches are suitable for controlling and compiling data with little loss. As an Inventory Business Value, this documentation flow may be configured by employees themselves which adds NVA (Not Value Added) activity to the scale of the board.

TABLE 1. VARIABLES USED FOR SEE

Effort Estimation Model	Attributes	Reference	Explanation of DBs
Customer	Company	ISBSG	Design configuration
Request	Request type	Maxwell, ISBSG	-
Project year	Calendar	Kitchenham, ISBSG	Report of request
Description	Feedback	-	CA request manifest
Department	Personnel	-	Analyze of request
Effort estimation	Expected effort	Kitchenham, ISBSG	Time Spend analysis
Total effort	Real effort	All data sets	Formulation of effort

Software effort estimation is not an easy task. The forecasts are then the basis for planning, schedule adjustments, budget, and some other agreements. When the planning and budget values are not correct, the expected gain from the project may not be achieved. (Ömer Faruk Saraç, Nevcihan Duru, 2017)

As we already debated, although this governance demonstrates the basics for the next time, resource, and cost schedules, it's not that easy to estimate the effort of the project before it starts with the highest accuracy, If the project doesn't meet with a required agreement, owners and managers may not be able to earn as much as they planned.

Relevant Investigations in the field

ANNs also have been used in effort estimation in many studies regarding COCOMO. Although the architectural choices differ in these studies, it can be stated that the feed-forward network is generally the preferred one. In general, COCOMO-based datasets that can be accessed are used in studies. B Boehm presented a dataset in his publication where he also gives the definition of COCOMO and uses this dataset in comprehensive aspects. Choosing this data set in the studies also provided the opportunity to compare the models with each other. Reddy takes a similar approach. Again, COCOMO-based ANN was used in his study. The original COCOMO model was transformed into logarithmic form, and it was stated that there were 2 basic parts in this way. One of these parts expresses the cost factors, the other forms the formula multipliers. (Ömer Faruk Saraç, Nevcihan Duru, 2017)

The proposed model and specified data sets

The mode includes similarity with our intended proposition, as a time-boundary limiting is the main target of this case study. The user's output was planned as a time scale rather than a single effort number. Proposing such an approach relieves pressure and allows governing risk management exhaustively.

For the validation of the model 81 different datasets were used with 63 lines per dataset. During the research different values were implemented and normalized. Then minimum and maximum lines are detected. 75% of the whole data was used for training the model and the rest for the validation. With the help of random functionality, 2 different subsets were defined and evaluated.

The selection of random variables is important due to the impact on outputs. In the investigation, It also has determined that the start variables are affectable specifically in the k-means algorithm. Therefore, during the train and test phases, the model used a methodology that allows characterizing desired outcomes.

2.7 DESCRIPTIVE QUALITY FACTORS OF EARLY-STAGE EFFORT ESTIMATION

In the light of the recent investigations, in this section, we will be defined and describe the main estimation factors that should be taken into consideration while forecasting. These factors are very basic for the prediction stage of a project, however, that's the way will carry us out to the main model attributes that will be used in the development of the model.
Some of those quality factors have been described below, where we can use the advantage to justify our future independent variables of validated model:

- Understanding of the topic
- Personal experience
- Resource alignment
- Team collaboration
- Unplanned events
- External changes
- Expert assumptions

As per our data collection, although we have fairly achieved and quite reach quality and quantity factors it may still seem difficult to compile the right variables for the training phase of the model.

The model will take the sizing technic of source line codes and/or function points as an initial requirement. For this purpose, special grouping lists as, Rating, Organization Type, Industry Sector, Application group and type, Programming Language and its type and approach, as well as Functional Size, Adjusted Function Points, etc. will be defined and performed.

2.8 Artificial Neural Networks in Software Development Projects

This section decided to present the modern and most known approaches of Neural Networks methodologies in Software Development Projects. The models mentioned below are the fundamental stages and creations of SEE applications during the specified time frames:

- Barry W. Boehm 1981 "*COCOMO model for estimating the cost, and schedule for waterfall models of software development*"
- Jorgensen, 1995 *"Compared baseline, regression, neural networks in calculating effort"* (NN with BP algorithm)
- Finnie, Witting and Desharnais, 1997 *"Considered CBR, ANN, and regression analysis techniques using functional points"* (BPNN)
- Barry W. Boehm 2000 *"Software cost estimation with COCOMO II"*
- Shepperd and Kadoda, 2001 *"Suggested model and compared stepwise regression, Case-based reasoning, and neural nets"* (SWR, RI, ANN)
- Jun and Lee, 2001 *"Propose search model to find relevant cases for neural networks"* (BPNN with Quick prop Algorithm)
- Reddy and Raju, 2009 *"Compared NN using BP algorithm with COCOMO model"*
- Attrazadeh and Siew Hock Ow, 2010 *"Proposed COCOMO II based on ANN compared to COCOMO"* (BPNN)
- Kaur et al., 2010 *"Compared ANN with Different old estimation models"* (BPNN)
- Nassif, Capretz and Ho, 2012 *"A novel ANN model for effort estimation using case model with use case point"* (FFNN)
- Sarno, Sidabutar and Sarwosri, 2015 *"Compared COCOMO II, Fuzzy and NN models for effort estimation"* (FFNN with BP)
- Kumari and Pushkar, 2018 *"CS-COCOMO, CS-ANN-COCOMO II are proposed to calculate effort"*

The model suggestions use different approaches as a contribution, method, dataset, and evaluation factors to success in the forecast. Models were evaluated and approved for the most of the projects. As it's hard to estimate the final effort for all project developments, organizations may use different tools to compare the results.

To create a good estimation, model the structure of these models was recognized and analyzed. The network connections, weight arrangements, node relations, flow destination are a few of the components that are detailly examined and evaluated.

If we look at the very recent research in the field (P.Kumar, H.S.Behera, A.Kumari, J.Nayak, and B.Naik, july 27, 2020), we can observe figure 16 which accommodates different ANNs methodologies and contributions in SEE which are distinguished by their assigned datasets, methods, and evaluation factors.

Table 1
Various neural networks in software effort estimation.

S. No	Author(s)	Contribution	Intelligent method	Datasets	Evaluation factors	Ref
1	P. S. Rao et al.	Proposed MLPNN with ABC, and compared with MLPNN, and MLPNN with PCA	MLP, PCA, ABC	COCOMO	MMRE, MdMMRE	[12]
2	Ali Idri, Abran, et al.	Compared the performance of RBFN with c-means and RBFN with APC-III	RBFN, C-means, APC-III	COCOMO'81	PRED, MMRE	[13]
3	Rao and Kumar	Proposed Generalized Regression Neural Network with PCA, and compared with M5, linear regression, SMO poly kernel and RBF kernel	GRNN with PCA	COCOMO'81	MMRE, MdMMRE	[14]
4	Vinay Kumar et al.	Proposed WNN and compared with MLP, RBFN, MLR, DENFIS, and SVM	WNN with Morlet function, WNN with Gaussian function, TAWNN	CF, IBMDPS	MMRE	[15]
5	Benala et al.	Proposed FLANN with C-means and compared with FALNN with k-means, SWR, and CART	FLANN with fuzzy C-means	COCOMO'81, Nasa93, Maxwell	MMRE, MdMRE, PRED (0.25)	[16]
6	Venkataiah et al.	Proposed SNN and compared with RGP, GP-RGP, GP–GP, GMDH-GP, GP-GMDH, PSO–ABE	Spiking neural networks	IBMDSP, ISBSG-10, China	RMSE, MMRE	[17]
7	Choetkiertikul et al.	Proposed Deep learning with story points, compared with lstm+rhn, lstm+rf, lstm+svm, lstm+atlm, lstm+lr	Deep learning with story points	16 open source projects	MAE, MdAE, SA	[18]
8	Praynlin and Latha	Proposed ELMAN neural Network and compared with back propagation algorithm	ELMAN neural network	NASA	MRE, MMRE, PRED(25), RMSE, Error	[19]

FIGURE 16. EXISTING MODEL SUGGESTIONS IN THE FIELD OF EFFORT ESTIMATION

2.9 SYSTEMATIC REVIEW ON USING ARTIFICIAL NEURAL TO NETWORKS MAKE SOFTWARE EFFORT ESTIMATION

The scientific and systematic establishment of the review methodology primarily provides a high-quality basic knowledge base. As I mentioned earlier in the research flowchart, the scientific databases used to create this paper generally are Google Scholar, Science Direct, Springer, Elsevier, ResearchGate, and PubMed. In addition to this, I have benefited from different online internet sources that extremely impact our research.

To demonstrate the initial dimensions, I have applied "DistillerSR" with particular data selection phases. The platform allows creating custom labels/forms, to reduce time spent on the topic and improve measure control in a new systematic way. We will talk about the data selection process in the next lines.

Questions, form creation, and level instructions

As a systematic review method, the platform supports scientists during the screening, data extraction, quality assessment, and meta-analysis stages of literature review. The systematic methodology of Artificial Intelligence is ensuring rapid review and quick conclusions. It unites electronic databases with conducted references. The following benefits had explored (Peter O'Blenis, Beata Smela-Lipińska, Vanessa Taieb, Clement Francois, 2018)*:*

- The decisions made by the vehicle are well qualified.
- Only a small part of the references was answered.
- Useful in controlling excluded hits.
- Reinforcing confidence in our selection of articles.
- Methods are evolved rapidly and required constant testing.

The field study in the field overviewed by 598 Dutch companies shows the result below:

- 35% of the total organizations do not even make an estimate
- Half of the participated organizations do not record data on the activities of the ongoing projects
- Almost 60% of companies do not use cost-accounting
- Around 80% of the projects have cost overruns and the budget exceeds during the design, execution, and closure phases. (Heemstr, 1992)

So that, the relevant questions are composed and used while reviewing the references. These questions partly will be represented.

To make a small overview of DistillerSR, the process lifecycle is just sufficient. Practically, the management of every particular project determines the desired set of search criteria adopted in the first stage to turn into rotation. So, in the stages described below, the user can take advantage of the selected research papers and also remove them if they don't meet with search criteria and/or they aren't relevant to the target we aim to achieve.

- Firstly, it's being sure that the allocated paper is going to be needful for the research. This stage calls screening and includes the questionnaire that detects whether the selected topic will be enrolled in the next form or not
- The screening phase allows getting full-text retrieval before extraction. The stage provides scalability to inspect sizes from small to large. In case of any contradiction, the label expresses a statistical view for resolving issues and removing doubts – under the list of *Conflicts*.
- Data Extraction aims to create a descriptive summary of the results which addresses the scoping review's objectives, and ideally answers the questions of the review
- Quality Assessment is the data collection and analysis through which the degree of conformity to predetermined standards and criteria are exemplified
- Meta-Analysis

The application allows specifying particular objectives and creating relevant research questions that define the report's level instructions. The forms created emerge at every stage to control the importance of the article is dedicated with the main purpose.

Some of those questions are:

- Does this report include target demographics?
- Were incomplete outcome data adequately addressed?

- Is the review team's aim for this result?
- Was the allocation sequence random? …etc.

The next statistical review of Screening indicates the research priorities that were answered with the help of the determined questions. Table 2, shows the average percentage of materials/sources that have already been studied.

Regarding the question, the platform shows the percentage of data with several used resources. It helps to reduce the time-consuming while reviewing the reports. The most relevant sources go to the next level to examine better.

Within the Distiller, I used different internet sources and book sections to structure the literature review smoothly. The following components were included in the literature review with the help of these articles, articles, books, and online resources:

- Collecting the information regarded to the reputable publishers and credible publishing houses
- Analyzing the professional proceedings, and well-prepared papers from research institutes.
- Considering the non-limited sources which as, scholar websites, free communities, Wikipedia, etc.
- Discussing relevant sources within the general introduction that frames the hierarchy of research
- Identifying and evaluating the reached point and working on gaps
- Using the previous investigation to examine and consolidate the literature review within the references that are relevant to the topic.

With the platform, I added sources from different databases that can be useful in our research. During the review, valuable references had been included within the bibliography. The accuracy of the reference list is quite mandatory for using the least amount of time to achieve a high level of the knowledge base. This base of information allowed understanding, clear, investigation and compare the sources.

Once the special set of knowledge sources was defined, I determined the main functionalities analyzed and added to our research paper. The intention was aiming to build a good reference for the researchers in the future.

The adequate table of statistics is represented individually in Table 2. These will be only a few of the questions I used in the tool for investigating the issue.

TABLE 2. STATISTICAL VIEW OF FULL-TEXT SCREENING

Statistical

Question	Answer	Vusal.Orujlu	Total	Average
Is it related to content?	Yes (include)	82.47% 127 -	127	82.47%
Is it related to content?	No (exclude)	5.84% 9 -	9	5.84%
Is it related to content?	Can't tell! (include)	11.69% 18 -	18	11.69%
Is incomplete outcome data adequately addressed?	Yes!	31.17% 48 -	48	31.17%
Is incomplete outcome data adequately addressed?	Somehow!	33.12% 51 -	51	33.12%
Is incomplete outcome data adequately addressed?	No!	1.95% 3 -	3	1.95%
Is incomplete outcome data adequately addressed?	Unsure!	3.90% 6 -	6	3.90%

How was the simplicity of finding this paper?	Tough	30.20% 45 -	45	30.20%
How was the simplicity of finding this paper?	Straightforward	32.89% 49 -	49	32.89%
Were selection criteria clearly described?	Yes! (include)	95.30% 142 -	142	95.30%
Were selection criteria clearly described?	No! (exclude)	1.34% 2 -	2	1.34%
Were selection criteria clearly described?	Still unsure! (include)	3.36% 5 -	5	3.36%
Is the time period between reference standard and index test short enough to be reasonably sure that the target condition did not change between the two tests?	Yes	76.51% 114 -	114	76.51%
Is the time period between reference standard and index test short enough to be reasonably sure that the target condition did not change between the two tests?	No	13.42% 20 -	20	13.42%
Is the time period between reference standard and index test short enough to be reasonably sure that the target condition did not change between the two tests?	Unclear	4.03% 6 -	6	4.03%
Did the whole sample or a random selection of the sample, receive verification using a reference standard of diagnosis?	Yes	67.11% 100 -	100	67.11%

The application allows specifying particular objectives and creating relevant research questions that define the report's level instructions. The forms created emerge at every stage to control the importance of the article is dedicated with the main purpose.

Some of these questions are:

- Does this report include target demographics?
- Were incomplete outcome data adequately addressed?
- Is the review team reached the desired result?
- Was the allocation sequence random? …etc.

Statistical #FTS

In the statistical view of SLR, we can check and control the amount of data collected, used, excluded, and analyzed. To clarify the questions up, not only the resources I received and used via a platform, but the full amount of the researched sources will be visible in Prisma Flow.

The tool (SLR) allows using the PubMed database and adding extra articles or online sources. The software also includes the DistillerAI option to review materials with minimum effort and time. Although, the tool mainly includes the values from the health states, with imported data I increased the total number of relevant scientific papers in the database.

Double check-ups during scanning phases help prevent and reduce conflicts and unresolved issues. The results obtained by observing 450 references with a specific study are discussed as follows:

- Depending on the size of the training data, the platform endorsed the decision for 9% to 15% of fully reviewed articles
- While increasing the training data set, it is possible to enable the system to make more accurate decisions on the relevant references
- The result shows that the platform is quite useful for users to combine, scan, conduct, and analyze research methodologies (Vanessa Taieb, Peter O'Blenis, Clement François, 2018)

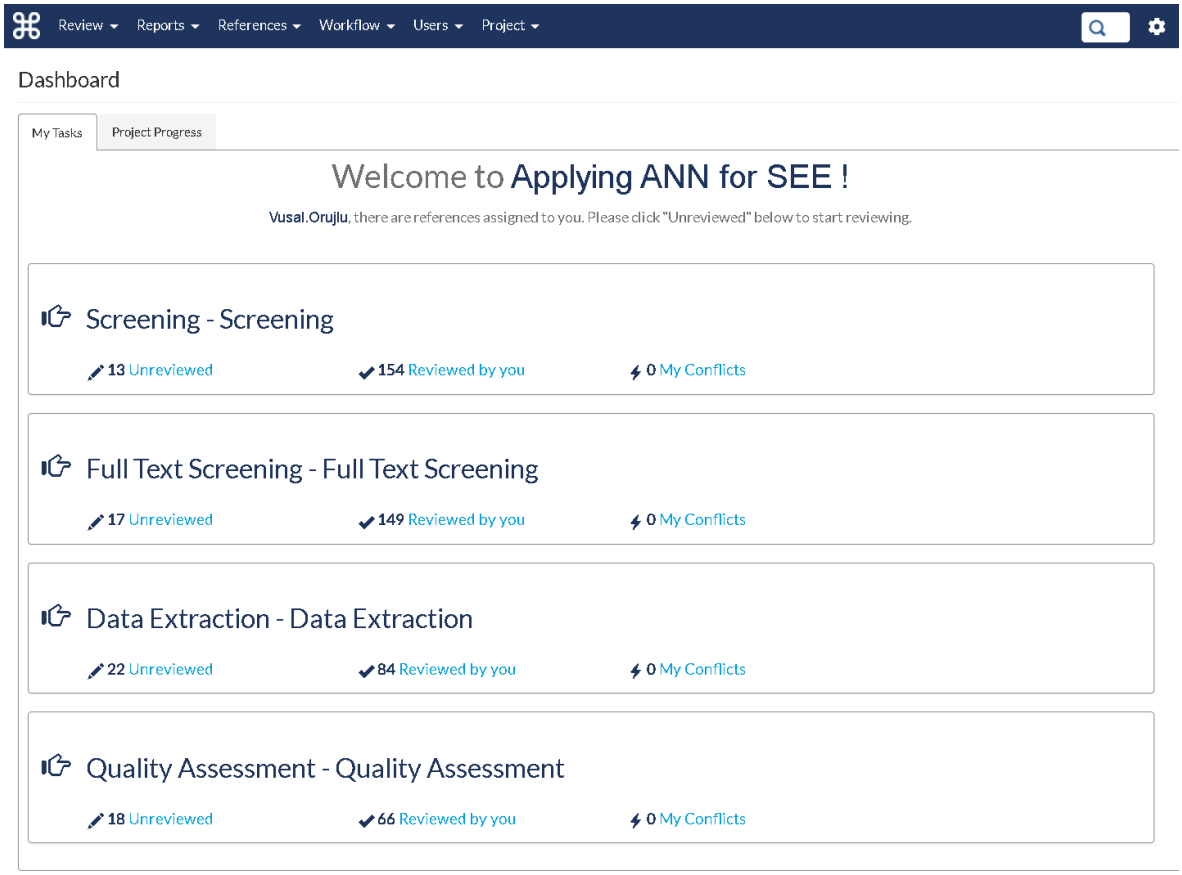


FIGURE 17. RESEARCH SYSTEMATIC OVERVIEW

As shown in the systematic review, 154 research papers were selected and added for screening. Separately, 149 papers in full-text screening and 84 sources were used in the data extraction. At final, 66 articles were reviewed in the quality assessment stage. Although not all these papers were included in the thesis work, most of them were evaluated and added together with other online sources.

2.10 CASE INVESTIGATION – "FROM NEURAL NETWORKS TO DEEP LEARNING"

This recent investigation in the field consists of major factors that should be considered during the knowledge base and model creation phases.

There are several amounts of inquiries, surveys, and questionnaires to demonstrate - so to say, the doubt boundary of Software Effort Estimation. In another word, not all databases are suitable to use, and/or not every project segment is important to indicate as an input variable. Then what is remarkable information for developing a well-desired estimation model? Why don't all estimating calculators show high accuracy in effort forecasts? How to increase consumer satisfaction with reliable and confidential outputs?

To be able to find answers to those questions, the research refers to this individual survey. The survey includes specific questions for finding answers to understand the new developments in the field of Software Effort Estimation.

The section properly serves to investigate and figure out the main considerable aspects of effort estimation during model development. These aspects

The results escalated regarding such elective databases as, Science Direct, Springer, Elsevier, Inderscience regarding other optional databases such as expended. The analysis begins with a total of 194 papers with approximately 80 positive output articles. The study of this questionary is important not only to introduce initial techniques but also to demonstrate the special formulation at the model building stage.

The survey illuminates some confusing points.

- The importance of database used in training
- Which techniques, datasets, and accuracy variables are mostly used in Software Effort Estimation?
- What are the advantages and disadvantages of using single or multiple amounts of databases?
- Which models are mostly considered ones in the area?
- Comparative investigation of intelligent model's performance and future work (P.Kumar, H.S.Behera, A.Kumari, J.Nayak, and B.Naik, july 27, 2020)

Since a good estimation creates a strong baseline for the planning, implementing, controlling, executing, and closure of the project, the questionnaire aims to use given data for analyzing the improvements in the area of SEE between 2000-2020. Almost 65% of the whole data was maintained as a model for the effort of development. The size and time effort estimation approaches were about 5% while the rest served for the cost effort estimation. The researchers used different types of methodologies as FFNN, BPNN, FLANN, etc. to predict the effort.

At the end of the investigation, it has been evaluated that the most used neural networks' architecture is the Feed Forward with backpropagation and multi-layer perception. Thus, it will also be a general methodology for our research and model creation. The proposed model will use a different number of layers, hidden units with backpropagation to find and fix the errors in every iteration. The investigation also shows that using these techniques can allow building a much more accurate prediction model.

It has been concluded that imputed data plays important role in the development stage. The legacy and reliability of data are important as the architecture and hierarchy of the model. If the training session completes with a high number of error degrees (ASE), the applied model isn't able to bring high accuracy level.

3. METHODOLOGY

Although industry accommodates a variety of forecasting models, the estimators are only efficient with relative datasets used in training and validating phases. That's what, the collected data (processed from ISBSG) will be the main foundation for our research variables.

For this purpose, it was decided to use Design Science Research (DSR) as a functional methodology. Thus, the important phases of the dissertation paper will be presented and explained for the understanding of the research stream.

Since the goal of the research is to produce an Artificial Neural Networks model for use in the field of Software Effort Estimation, the desired model is an artifact. The suggested work model was used by Peffers, to establish the research cycle, to find the best artefactual solution. The remarked diagram includes time-bounded activities from defining a problem phase until evaluation and communication milestones. During the next subchapters, we'll be discussing the benefits, targets, success criteria of methodology with a suggested sample.

3.1 DESIGN SCIENCE RESEARCH

The section below is aimed to describe the design of science research. The activity flowchart has to have consisted of major stages of research. In order to finally arrive at the right conclusion, the structure of the research must be defined at the start.

Design Science Research is a paradigm for problem-solving. With the aid of the root of the paradigm, it ensures step by step process cycle. The methodology provides sustainability at a transformation level. The overall DSR process is shown in Figure 18.

DSR basically seeks improvements while extending the limitation boundaries with new ideas and artifacts. The framework consists of people, technologies, and/or organizations. The methodology suggests guidelines used in the evaluation phase. (J. V. Brocke, A. Maedche, A. Hevner, 2020)

The proposed methodology uses the Design, Problem relevance, demonstration, evaluation, etc. In the next subsections, I will try to include the basic information of those stages separately.

In terms of design and development, the basic stages/work packages were determined and used in the diagram below. In recent years, various frameworks and paradigms for research design have been developed. Forgiving an instance, we can see the research design by Archer (1984), Walls (1992), March and Smith (1995), Hevner (2004), Vaishnavi (2005) and etc. (Ken Peffers, Tuure Tuunanen, Marcus A. Rothenberg and S. Chatterjee, 2007)

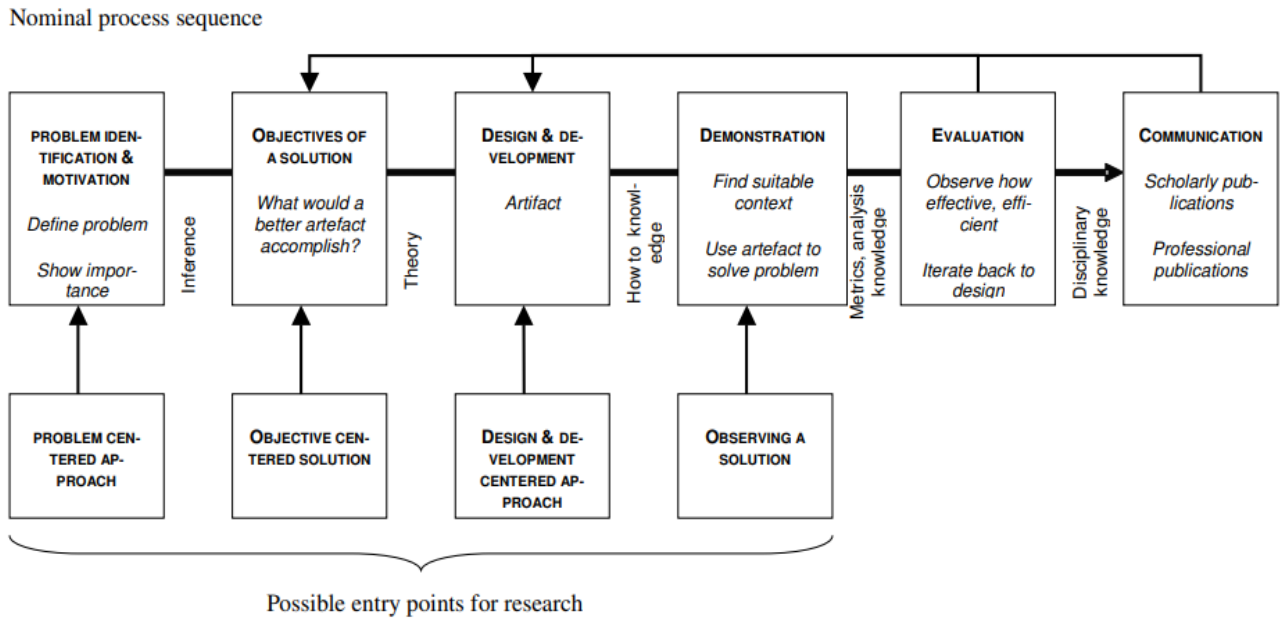


FIGURE 18. RESEARCH PROCESS OF DESIGN SCIENCE (KEN PEFFERS, TUURE TUUNANEN, MARCUS A. ROTHENBERG AND S. CHATTERJEE, 2007)

3.2 RESEARCH STRATEGY

The research strategy involves the natural sequence of defining the problem, finding a solid solution to the problem, finding the appropriate context, and observing how efficient the final model is. The research phases of strategy are explained below:

Step 1 - Problem How can we make Software Effort Estimation

- For working on a particular solution, the research question was identified and qualified.
- The paper mainly addresses two major aspects: 'Why are early-stage project estimations rarely accurate?' and 'What are the key components to consider while providing a forecast'

During the literature review, I tried to classify the main contents for good project estimation. Those indexes will be evaluated while selecting attributes within the given dataset.

The dataset includes Software Development Projects with a rich number of components that can be considered in the development phase. This set of data will be presented and investigated in the related chapters.

Step 2 - Proposing an Artificial Neural Networks model to improve the accuracy of effort estimation in Software Development Projects. The model is planned to train on specific data then validate the accuracy and observe the score. To find the unique model lots of connections will be used.

Given that there are similar models in the industry, the attributes will be inserted differently while maintaining high accuracy. The model will use Function Points as Sizing Method. Unadjusted Points will be assigned in the input layer to achieve the desired target.

Step 3 - Build an artifact

To build an artifact that can address the research methodology, the necessary literature review was observed. The research mainly has included a systematic review on using artificial neural networks to make effort estimation of software projects. The literature review process is composed of 5 steps, as follows:

- For to reach the fundamentally significant knowledge base I performed a literature review using related books, articles, journals, relevant scientific papers, and research in electronic and online sources via ResearchGate, Google Scholar, etc.

- To find the interrelated components of ANNs and Deep Learning, which are the main components in the process of determining the component information received as primary data into the review

- For understanding the main components of early-stage project estimations, I defined the results of case studies and included them in the knowledge base

- For study ANNs algorithm and its working procedures, I tried to take advantage of practical investigations to concretize the important matters that should be accounted

- To build the desired model, I used many of the training sessions with given data to find the best solution to apply. The final model will be developed until the highest accuracy of estimation is handled

Considering the notes remarked, I would say after reviewing the literature that the reasons for poor estimation of effort can be due to different reasons. Therefore, I will select the most impactful causes as variables of the model (among the imported data) to compare and evaluate the most common causes.

During the search for the most realistic solution to the problem, the ANNs model will be counted as an artifact of the solution. Discussions will then be presented about what the scale of worth reasons is for the variables identified.

The aim is to build a model (as a general objective) with a certain ability is the ending of all conceptual and practical research to ensure the final mission. The model will consist of the main substances of the IT projects, to train based on those dedicated components. With the aid of the training, the new concept will be validated and tested to realize the accuracy of the model to take precautions in case of any incomprehensibility.

Step 4 - Demonstration

- The variable selection criteria will be used based on the literature review. The attributes will be considered and analyzed. These attributes then will be the main input and outputs in the developed model

- For the demonstration process, I will use SAS Enterprise Miner to build, train, validate, and test the model. The platform is one of the most used techniques to develop Artificial Neural Networks and usage of this method will provide much more convenient outputs. I'm using the version of 15.1 which has more advanced features and the detailed result of tables, charts, and statistics

During the creation process of the ANNs model, I will also consider other types of models (included in the tool) to view the results and compare them with the main Artificial neurons. If necessary, more network connections will be created.

The architecture and optimization options and decisions will be explained and presented. The methodology of implementation of the model is backpropagation with the feed-forward flow.

Step 5 – Evaluation

- The evaluation of the proposed model will be confirmed after reaching a satisfactory result. The discussions of results will then be compared and agreed upon.

- The validation of the model will be counted as having an output with the utmost high accuracy of estimation. The percentage of accuracy of estimation will be displayed in the next chapters as to how it has been compiled and evaluated

Considering that the models with a misclassification rate of over 65% are approved as successful models, our final evaluation will be based on this theory. Any kind of accuracy scale below this percentage will not be considered as work completed.

In the end, I'll try to communicate with the SAS Enterprise Lisbon Office for getting more assumptions and feedback on the developed model. I will try to reduce the amount of misclassification rate as much as possible in order to achieve the most accurate value.

I will confirm the validation of the model with the Community of SAS.

Step 6 - Communication

Communication consists of scholarly publications.

The research includes a special process cycle to follow up. Figure 19. briefly describes these steps in a flowchart diagram. It is generalizing the study from the very beginning of research until the model validation phase.

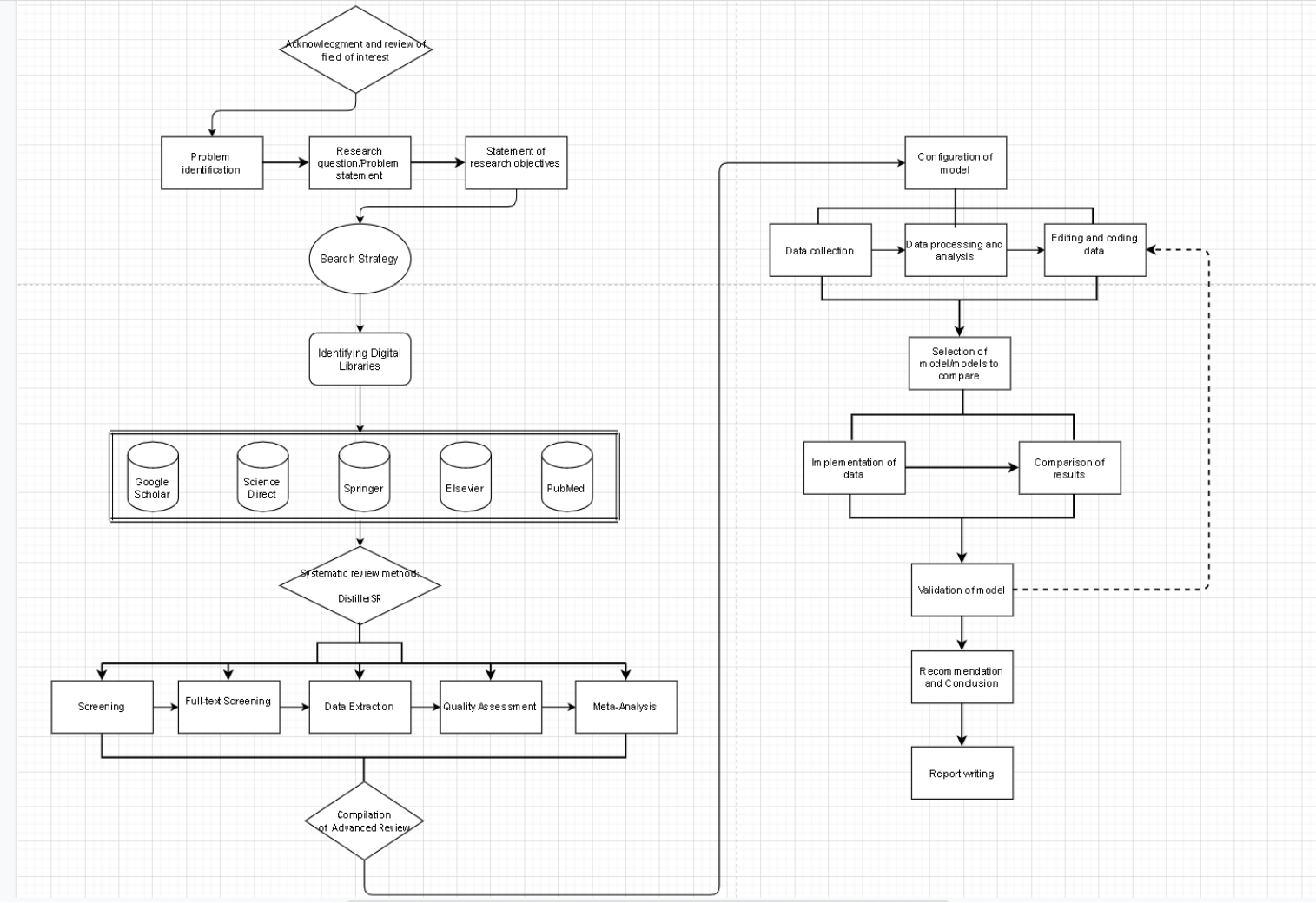


FIGURE 19 RESEARCH FLOWCHART

As described in the diagram above, the research proposal starts with defining the problem statement and research objectives. After deciding on the research definition, the idea came into the existence with a particular approach. Then, Digital Libraries were determined and researched to gather the necessary information. We will explain the basic execution and hierarchy of the Systematic Review Method in a subsection followed by SLR statistics and Prisma Flow Diagram. Options for screening, collecting, extracting, and meta-analysis of collected data were used to compile the information.

After the advanced literature review, the structuring of the model becomes the second main part (namely the practical part) of the research. Data was collected from the ISBSG Group Community in light of academic research requests. The collection of the data set consists of approximately 10 thousand Software projects. The project preferences and input variables will be determined comprehensively in the Proposal section.

As stated, and explained before, the model is planned to predict the effort of estimation of Software Development Projects with the help of Artificial Neural Networks. So hopefully after the successful build of the model, I will be comparing the results with other remarkable tools and models to fully validate the model. Finally, I will define the recommendations and conclusion, as well their understandings for future works.

4. PROPOSAL

Based on the literature review, the main assumptions, general description of the method, proposed model and its features, attribute configuration, use case, data source, evaluation, and discussion are defined and implemented. We definitely should recognize these remarked functions for building the aimed model with the desired output.

In this paragraph, we will see in detail Artificial Neural Networks flowcharts, illustrations, and statistics. The outputs of the training, validation and testing phases of the applied model will be presented and discussed. We have already cleared the main functions to be used in the architecture of the model and defined the methodology to initiate the optimization of the model. Optimization includes selected technique, iterations, time, absolute function, absolute gradient, different levels of parameters, and preliminary training.

4.1 ASSUMPTIONS

As a general summary of the literature review and analyzed cases, particular measures were identified to be implemented in the proposed ANNs model. To provide the theoretical knowledge base, the following acknowledgments have been acquired:

- In advance, the methodology begins with exploring the necessary resources of Software Effort Estimation, according to the latest studies in the field, the main publications were determined as Springer Series and Expert Systems with Applications. Besides, *IEEE Xplore* International Journal of System Assurance Engineering and Management (*IJSAEM*), Journal of Information Technology, Neural Computing and Applications (*NCA*), Applied Soft Computing, etc. were considered within the environment. (P.Kumar, H.S.Behera, A.Kumari, J.Nayak, and B.Naik, july 27, 2020) The remarked sources were planned to research for having an initial shape and scope of research.

- To detect the particular SEE technique of the proposed model, special and common predicting techniques are compared. Succinctly, the horizons of the environment contain the architectural fundaments of Neural Networks that are involved in the SEE. It has been acknowledged that the methodologies of Elman NNs, COCOMO, COCOMO II were used less regarding the recent studies. However, it also has discovered the General Regression NNs, Radial Basis Function Network, and Feed Forward NNs with BP and MLP are used and evaluated most commonly in the project forecasts.

- The previous investigations show that the most used datasets for Software Effort Estimation are: COCOMO, NASA, ISBSG, IBMDPS, etc. Obviously, the set of data is much more useful and reliable when it belongs to projects of the same organization/community. We will be using the specific dataset obtained from the International Software Benchmarking Standards Group (ISBSG LTD).

- Since the main target of our research aims to use the general based regressions technique, the methods of hybrid estimation were defined not to use as CS-ANN-COCOMO, FLANN-GA, RBFN-WOA, or PSO-FLANN, and so on.

- To define the input variables of training the concrete components were examined and selected. Those functionalities Major Project Grouping as the Industry Sector, Organization Type, Application Group, Development Platform and Type, Primary Programming Language. The sizing options were considered as Functional and Relative Sizes, Adjusted Function Points, Value Adjustment Factor. It's planned to allow the user to specify the special parameters to start the estimation process.

- In the Software Effort Estimation, the attributes such as Case Tool, Used Methodology, Development Environment were considered for a better model suggestion.

4.2 General description of the predictive method

Since the proposed method is aimed to predict the effort that will be needed during the execution of a software project, it will bring up the phases of Cost, Schedule, Productivity, and total effort estimation as a primary output. Then it can also include many detailed development attributes within, such as adjusted function points, etc.

The network attributes and optimization functionalities (as an architecture of model, training technique) must be defined for running and validating the stage. The method of predictive model decided that the model will be using the multilayer perceptron and backpropagation as the main structure.

The sections below will be containing main functionalities and independent variables that will be used in the ANN estimation model and with the aid of these decisions the main model will be structured and trained.

4.3 ANN estimation model

The model will process the custom dataset as an import node to be used to train itself. After importing major datasets, the parametric statuses must be fulfilled. In the first step, the input and output variables are defined. The number of these entries indicates the first line of Neural Networks from which the flow starts.

Existing nodes are then connected to the hidden layers. Hidden paths receive and transmit information from inputs and reconnect the exported data to subsequent layers. The number of hidden layers is determined by the misclassification rate and the mean of the squared error. These dimensions will be discussed later on.

TABLE 3. VARIABLES OF PROPOSED ANNS MODEL

Name	Description	Data Type	Role
Industry Sector	Type of the project into a single value of a defined set	Nominal	Input
Organization Type	Type of organization that submitted the project	Nominal	Input
Development Type	Whether the development was a new development or enhancement	Binary	Input
Programming Language	The primary language used for the development	Nominal	Input
Architecture	A derived attribute for the project to indicate the application	Nominal	Input
Database System	The Database System will be used in project implementation	Nominal	Input
Development Methodology	Methodologies used during development (Agile, Prototyping, Waterfall, etc.)	Nominal	Input
Development Platform	Defines the primary development platform (as determined by the operating system used)	Nominal	Input
Hardware	Where known, this is the primary technology hardware platform used to build or enhance the software	Nominal	Input
Intended Market	Describes the relationship between the project's customer, end-users, and development team	Nominal	Input
Operating System	Where known, this is the technology operating system used to build or enhance the software	Nominal	Input
Relative Size	For major FSMs, categories the Function Size by relative sizes	Nominal	Input

Unadjusted Function Points	The count before adjustment by a Value Adjustment Factor if used (This may be reported in different units depending on the FSM method)	Integral	Input
Elapsed Time	Total elapsed time for the project in calendar months.	Integral	Target
Normalized Work Effort	Full life-cycle effort for all teams reported (for projects where life-cycle coverage isn't known, this value is the same as Summary Work Effort)	Integral	Target
Adjusted Function Points	The adjusted functional size of the project at the final count. This number is dependent on the counting approach used	Integral	Target
Total Project Cost	The total cost of the project (to the nearest whole currency unit)	Integral	Target
Summary Work Effort	Total effort in hours recorded against the project	Integral	Target
Productivity	Normalized Productivity Delivery Rate (in hours per functional size unit calculated as "Work Effort/Functional Size")	Integral	Target

As seen in table 3, I inserted used input and output variables with special description, data type, and role. These variables are configured in the platform during the data import process.

At first, the system proposes 3 hidden layers for the model of neural networks. It's also acceptable to reduce or increase the number of units. The arrows used to connect the nodes keep specific weights which instantly impact the calculation of train and validation output. Working to minimize and control error rates is essential to improve accuracy while being careful with overfitting. Therefore, a large number of hidden units must be used to achieve a more realistic output. Comparison of connected nodes, weights, and hidden layers allows the user to clear the errors and choose the most useful model.

With these notes in mind, the first proposed ANN estimation model was developed. The clear point at the first glance is that it is unrealistic to achieve the desired output as the networks must be used in different levels with comparable iterations and layers. Illustration of early Artificial Neural Networks presented in the next figure. As it turns out, our initial networks consist of input, output, and several hidden layers. 13 inputs were defined and used as Architecture, Hardware, Industry

Sector, Operating System, Programming Language, Unadjusted Function Points, etc. from the data given. On the other hand, Adjusted Function Points, Normalised Work Effort, Project Cost, Elapsed Time, Summary Work Effort, and Productivity were selected and applied as an output.

The Unadjusted Functional Points may be reported in different units depending on the FSM method. When a full-size cast is provided, this is calculated functionality not adjusted by any adjustment factors. Where a size breakdown is not provided, but a total adjusted number and adjustment factor is given, this is unadjusted functionality calculated from the given data. So that, we can also call it a Functional Size node in the import phase. The reason to use it as an input is to get the first sight from the user and to give more detailed information to the networks for train comprehensively.

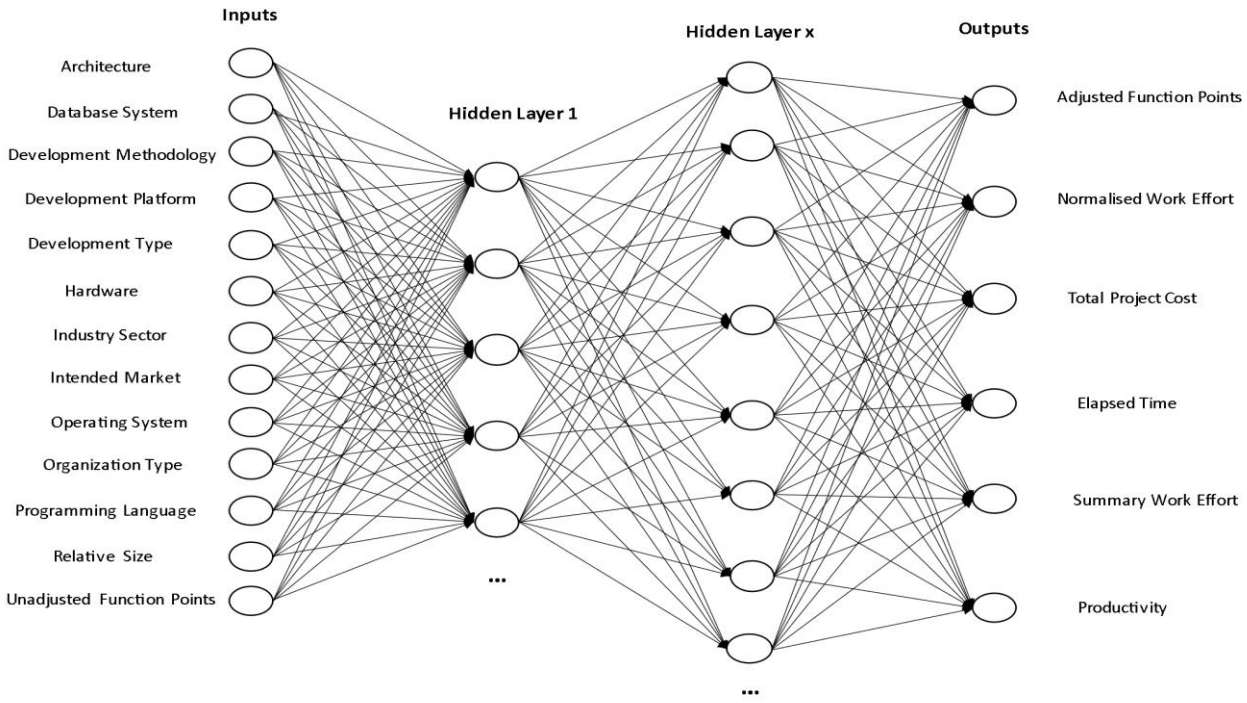


FIGURE 20. VISUALLY DEVELOPED ARTIFICIAL NEURAL NETWORKS

The Development Type is one and only one binary input node of networks as it describes whether the proposed project is an enhancement or a new development. The Efforts of Normalised and Summary Work are 2 interrelated outputs that ensure Boundary Value Effort Estimate in hours recorded against the developed project. The Effort of Normalised Work is the full life-cycle effort for all teams reported. For projects spanning less than a full development lifecycle, this value is an estimate of the full lifecycle effort for all teams reported. For projects where the full lifecycle scope isn't completely clear, this value is much closer to the Summary Work Effort. The numbers of these outputs create a boundary schedule that allows the user to define the Project total schedule comprehensively.

Figure 21 shows the model created based on the first Artificial Neural Networks hierarchy. Data sources were created and added to carry dates into the library. Then particular model packages are also defined.

After the imported dataset, I linked them to the sample and added the StatExplore node which generates summary and association statistics. Data Partition splits data into different tables with the status of training. In these terms, I defined 40% of data for train, 30% for validation, and 30% for testing phases. The number of train datasets will be reduced later. To modify and add missing values I used Impute node. The Metadata comes before the implementation of Neural Networks to modify the column's metadata for detected variables.

Then different Neural Networks are added with different hidden layers and iterations to find the best option (node with less amount of error) and decide to continue with. Besides, the Regression and Auto Neural nodes have been added to help find optimal configurations for the ANNs model. As seen in the figure, these model nodes are then connected to the Model Comparison and Score nodes to specify the success of the model.

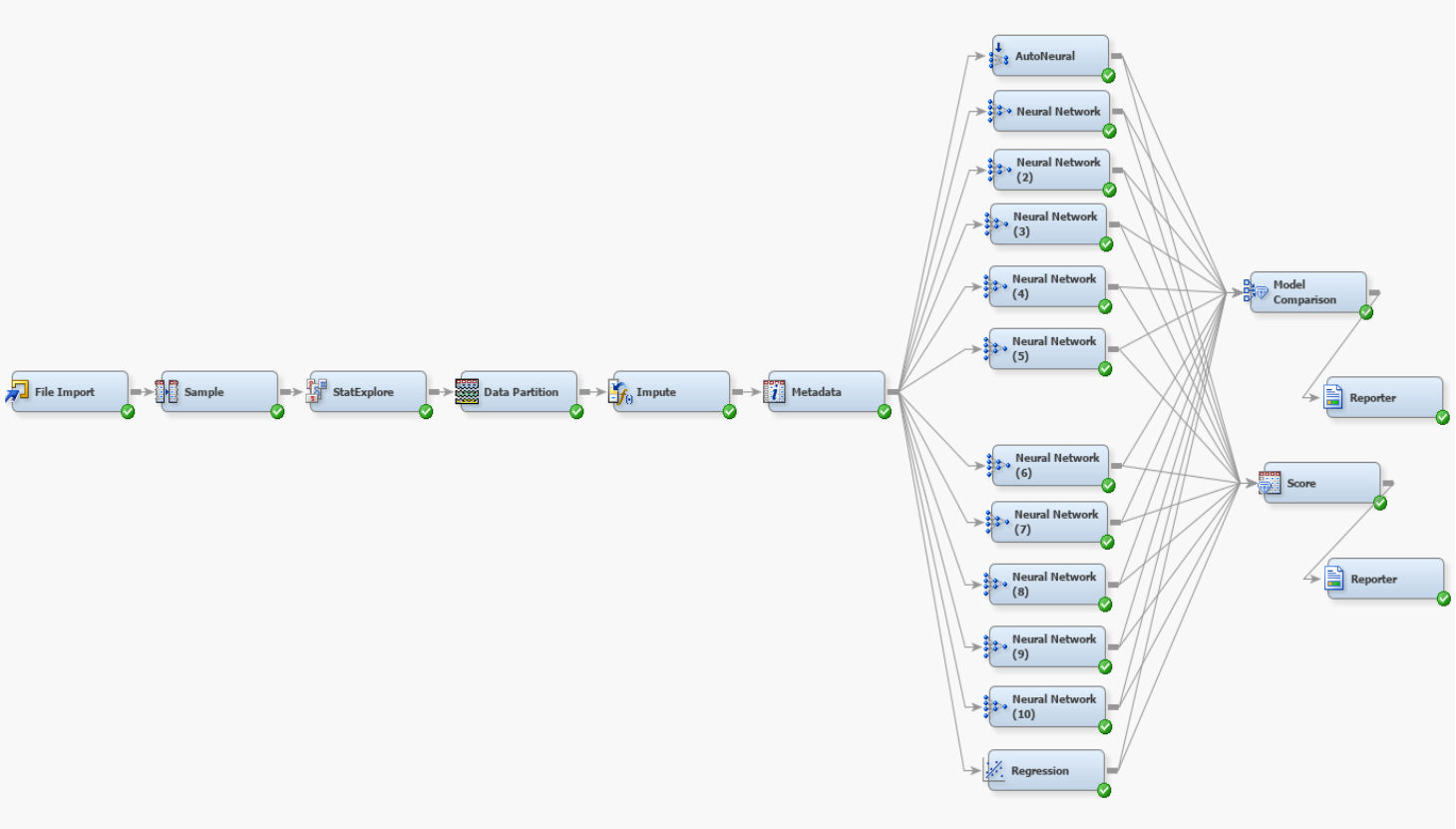


FIGURE 21. IMPLEMENTATION OF ARTIFICIAL NEURAL NETWORKS

As our decided outputs are integral variables, the main purpose is to find the node(s) with less amount of the prediction and squared error. To validate the model, we will consider the results of the phase of testing.

That was expected to not have desired accuracy level from the first architecture of the model. That's why the reports from decision and model comparison nodes were analyzed with all defined targets. The accuracy of the targets was monitored and evaluated.

The first model was helpful to understand the learning algorithm and node alignments better.

During the next phases of research, we'll see the error classification for the first Artificial model. The results show that the architecture needs more modifications to be validated.

The following tables include the main characteristics of the total amount of the targets created at the start which were adjusted function points, elapsed time, normalized work effort, productivity, project cost, and summary work effort. The statistics of these integral targets are as follows:

In this stage, we may discuss the results of the train, validation, and test stages and evaluate the selected attributes. Thus, we may compare the results for all of the selected targets. It's understandable if the model cannot succeed in all the train sessions. Therefore, the target of Overall will need more propagations to achieve the highest amount of accuracy.

The most accurate node of the model was the neural networks with 11 hidden layers. The backpropagation optimized main functionalities and the weights were specified accordingly.

After checking the statistics of output, it has been decided to demonstrate the new Neural Networks model with a final target of Overall for comparing the output of networks. To obtain more precise results, I decided to assign at least one input variable as an output (target) to observe and realize the error specification rate. By including the nominal target in the model, the platform itself calculates the misclassification rate.

The second model is configured to connect to the Overall target, to see and evaluate the total amount of error and level of accuracy. Previous targets were not removed, however, new targets were tested to minimize the average error function.

The number of hidden layers was updated according to the results of the first model. Thus, in the first phase, each neuron with 11 hidden layers is connected to new neurons at different units. The results of these nodes were also compared and evaluated. The model completed the run while using the different number of iterations and training timeframes.

We can check the updated architecture of new configured Neural Networks in the following figure. The previous outputs are linked to the overall target node, in order to add and use different weights in the error calculation step. It will let us compose a much more accurate model. Then these outputs will be compared again.

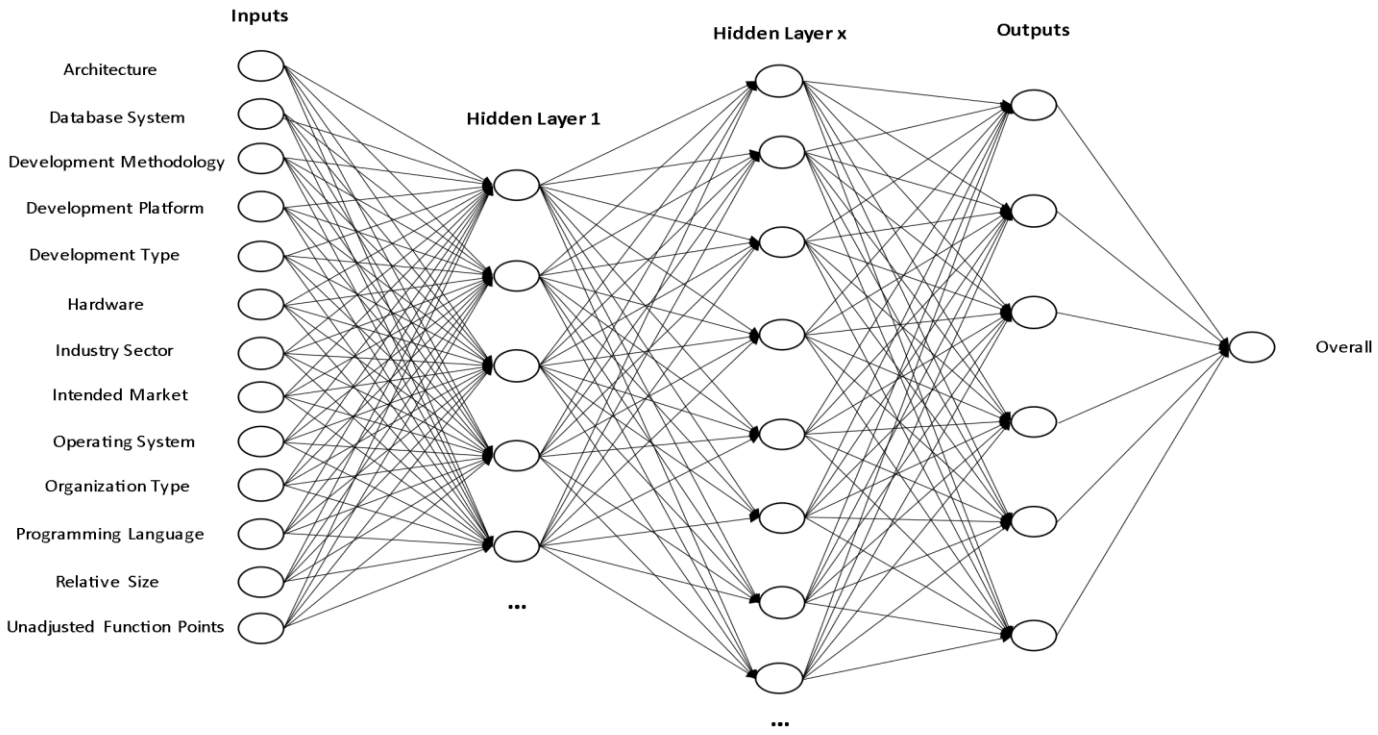


FIGURE 22. THE ARCHITECTURE OF SECOND ARTIFICIAL NEURAL NETWORKS

The second ANNs model includes 16 Neural Networks' nodes within the 2 interrelated levels. Different numbers of iterations and training times were used with the backpropagation method to find the most accurate weights of nodes. Scoring the results of these levels allows comparing and deciding on the correct path. Then these nodes of the model will be in the last diagram of the proposed Neural Networks to achieve the desired value.

The scores then were calculated and compared again. The model evaluates specific statistic labels regarding the target node. Some of those labels are total degrees of freedom, the number of estimated weights, Akaike's information criterion, the sum of frequencies, root prediction error, etc.

Considering that our outputs are completely integral variables, the label we will explore and discuss is the label of average squared error. Then the percentage of this error amount is calculated to find the true accuracy degree of the model.

Different type of model nodes was specified together with Artificial Neural Networks too. Utilities and applications were discovered.

The valid output of the Overall Train section will define our final estimation accuracy. With these numbers, the amount of error will be calculated.

The main aim in these terms will be to validate the model with at least more than 60% accuracy. Below this degree of accuracy is not the completely acceptable network. The percentage of accuracy will visually be represented in the following chapters.

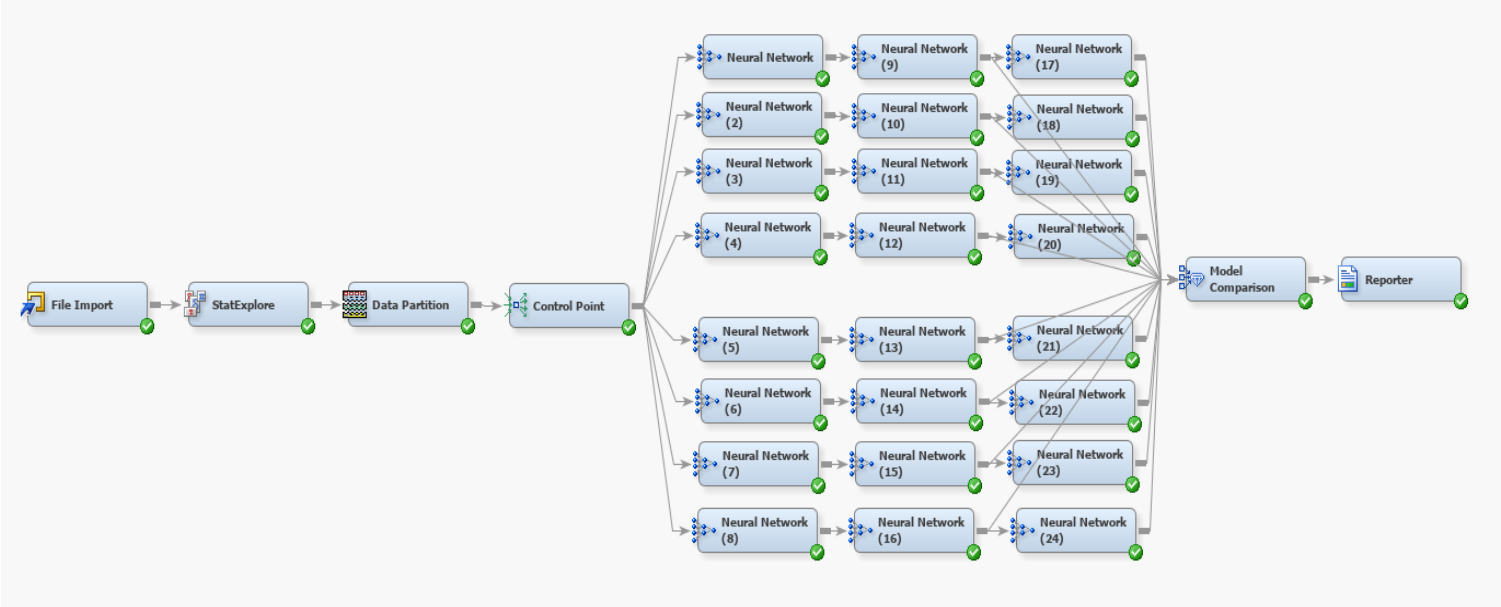


FIGURE 23. SECOND IMPLEMENTATION OF ARTIFICIAL NEURAL NETWORKS

In figure 23, we may see the second configuration of ANNs with specified nodes. Meanwhile, the outputs of the previous model are also used as an input one by one to realize if there's a way to improve the structure of the model. I couldn't claim many accurate values in that way, so in the model comparison stage, I used full values of nodes to compare smoothly.

The model generated summary statistics for the test and validation set of data while specifying the number of observations used in the reporting cycle. The report consists of input, and output, as well as other levels of variables.

The networks helped analyze and decide on the most accurate connections of the neural network's model for building the final model. The flows between neural networks iterate rapidly to produce the most beneficial outcomes. Once the reporter node was checked, it became clear that using variables in different roles could help to develop a better model.

At the same time, the nodes in the first and second levels are connected to the model comparison node to find the best architecture.

4.4 USE CASE

After defining the attributes and roles of the neural networks, the transportation of data is possible to the SAS Enterprise Miner to characterize the process visually. In the next figure main variables, labels, roles, levels, types, and lengths are represented. With the help of these attributes, imported data was classified and started to train. With connected weights remarked input variables got feed-forward with backpropagation to reach the output and repeated it until the error is minimized.

During the validation stage, some of these target variables also had to be used as an input for comparing all possible outcomes. However, the main purpose of the model has been considered in every stage of the investigation. The changes of variables brought the new results out. I tried to discover the most useful results, to make the model understand the process flow, and to indicate missing or incorrect values in the final model. The statistic view is screened from the reporting node of the model for presenting selected variables visually.

TABLE 4. VISUAL REPRESENTATION OF INPUT AND TARGET VARIABLES OF MODEL

Name	Label	Role	Level	Type	Length
Adjusted_Functional_Points	Adjusted Functional Points	TARGET	INTERVAL	N	8
Architecture	Architecture	INPUT	NOMINAL	C	36
Database_System	Database System	INPUT	NOMINAL	C	48
Development_Methodology	Development Methodology	INPUT	NOMINAL	C	131
Development_Platform	Development Platform	INPUT	NOMINAL	C	11
Development_Type	Development Type	INPUT	BINARY	C	15
Elapsed_Time	Elapsed Time	TARGET	INTERVAL	N	8
Hardware	Hardware	INPUT	NOMINAL	C	81
Industry_Sector	Industry Sector	INPUT	NOMINAL	C	33
Intended_Market	Intended Market	INPUT	NOMINAL	C	87
Normalised_Work_Effort	Normalised Work Effort	TARGET	INTERVAL	N	8
Operating_System	Operating System	INPUT	NOMINAL	C	68
Organization_Type	Organization Type	INPUT	NOMINAL	C	255
Primary_Programming_Language	Primary Programming Language	INPUT	NOMINAL	C	35
Productivity___PDR_	Productivity (PDR)	TARGET	INTERVAL	N	8
Project_Cost	Project Cost	TARGET	INTERVAL	N	8
Relative_Size	Relative Size	INPUT	NOMINAL	C	4
Summary_Work_Effort	Summary Work Effort	TARGET	INTERVAL	N	8
Unadjusted_Functional_Points	Unadjusted Functional Points	INPUT	INTERVAL	N	8

4.4.1 DATA SOURCE

The collected data includes specific and general software project components which aim to be evaluated as the independent variables (inputs). In the light of the registration of the academic research, we get provided with a quite rich and reliable set of data from the ISBSG Community.

Due to our research interests, I consulted to gather relative datasets of Software Development Projects to use in training and validation stages. The ISBSG is a not-for-profit organization founded in 1997 by a group of national software metrics associations. They aimed to promote the use of IT industry data to improve software processes and products. ISBSG is an independent international organization that collects and provides industry data of software development projects and maintenance & support activities in order to help all organizations and consumers in the software industry to understand and to improve their performance. ISBSG sets the standards of software data collection, software data analysis, and software project benchmarking processes and is considered to be the international thought leader in these practices (ISBSG, 2021).

TABLE 5. FREQUENCY COUNT OF VARIABLES

Role	Level	Frequency Count	Name
TARGET	INTERVAL	6	Adjusted_Functional_Points Elapsed_Time Normalised_Work_Effort Productivity___PDR_ Project_Cost Summary_Work_Effort
INPUT	BINARY	1	Development_Type
INPUT	INTERVAL	1	Unadjusted_Functional_Points
INPUT	NOMINAL	11	Architecture Database_System Development_Methodology Development_Platform Hardware Industry_Sector Intended_Market Operating_System Organization_Type Primary_Programming_Language Relative_Size

4.4.2 DATA DESCRIPTION

For implementing the model, a particular set of data was collected and used. This data was imported to the platform at the very beginning of the process as it has been remarked.

The description of data consists of a quite big amount of attributes with about 10.000 rows assigned to 50 columns. The most related attributes were selected and applied to the model from the set of data. These columns consist of major grouping, sizing, effort, productivity, schedule, case tool, methodology, environment, server, platform, etc.

To compare the results in a much more reliable way only some of these components were used and trained. These were the components that were found during the literature review as the most impacted reasons for effort estimation.

ISBSG supports a big number of datasets for use to validate the Artificial Intelligence models. For the subscription, I handled a special student discount of about 90% and paid 210$ for a 1-year membership.

Order for the data was created in March 2021. The quantity and price alignments are described in the following figure:

You've received the following order from Vusal Orujlu:

[Order #8877] (March 3, 2021)

Product	Quantity	Price
Data Subscription	1	$3,000.00
Subtotal:		$3,000.00
Discount:		-$2,790.00
Payment method:		Credit Card
Total:		$210.00

FIGURE 24. ISBSG DATA ORDER DETAILS

The collected information consists of different types of origins, contexts, types of products and projects, and methodology. The structure of the dataset includes the following information:

Project origin

- The projects have been submitted from more than 26 different countries. Major contributors are the United States (22.5% of all projects), Netherlands (16.3%), Spain (15.3%), Australia (8.9%), Japan (8.8%), Finland (6.3%), France (4.9%), China (4.1%), India (3.4%), Canada (3.3%), Denmark (1.8%), Brazil (1.6%) and United Kingdom (1.0%).

- The projects were performed in more than 30 different countries. Major contributors are Spain (20.6% of all projects where the country of effort is known), Netherlands (15.5%), United States (12.3%), Finland (9.1%), France (7.1%), India (6.7%), Australia (6.2%), China (4.6%), Japan (4.3%) and Canada (3.2%).

Project context

- Industry sector: major sectors are Communications (25.6% of all projects where the organization type is known), Insurance (18.6%), Banking (11.5%), Manufacturing (10.7%), Government (10.2%), Medical and health care (6.6%), Financial (5.6%) Electronics/computers (2.5%) and Service industry (2.5%).

- Business area: major areas are Insurance (18.6% of all projects where the business area is known), Telecommunications (13.4%), Communications (11.8%), Banking (11.0%), Manufacturing (9.3%), Government (7.8%), Medical & Health Care (6.6%), Finance (5.3%), Public Sector (3.0%), Computers & Software (2.0%), Aerospace/Automotive (1.0%), Logistics (0.9%), and Utilities (0.9%).

Type of project

- Development type: 69.0% are enhancement projects, 29.3% are new developments, and 1.1% are re-developments.
- Intended market: 91.9% of projects are developed for internal use, (i.e. for the organization that contributed the project to the Repository), and 4.5% for external use. 33.1% are developed in-house and 66.5% are outsourced.
- Team size: 31.6% of projects have up to 4 people in the development team, 29.1% have 5 to 9 people, 20.5% have 10 to 19 people, and 18.8 % have 20 or more people.

Type of product

- Application group: 91.1% are business applications, 4.3% are real-time applications, and 3.6% are mathematically intensive applications.
- Architecture: 35.9% of projects for which this information is available have a client-server architecture, and 28.0% have a multi-tier architecture (there is some overlap between these groups of projects). 36.1% are stand-alone systems.

Development method

- Methodology: 72.9% of projects that describe methodologies report using a waterfall model. Other methodologies include Agile and/or RUP (14.4%), Joint Application Development (3.1%), Rapid Application Development (3.1%), Multifunctional teams (2.8%) and Timeboxing (0.8%).

4.4.3 EVALUATION

To evaluate the proposed Neural Networks, I created the last model diagrams by the ANNs nodes with the most accurate iterations. In terms of good accuracy, 3 different nodes of Artificial Neural Networks were defined and connected before completion.

For the partition of data, I used 50% for training, 30% for validation, and 20% for test phases. To check the error average with every target, I connected all variables individually to the process for validating the model. The average of error degrees for all model specification stages as, train, validate, and test were defined and considered. With the help of different models illustrated above, I clarified the most accurate values to use, iterations to add, and optimization to apply. The model itself includes bias execution as well. These first and last units of layers process the data before it goes to the next hidden layer.

Regarding the explanation, we can observe in Figure 25. as the final structured Artificial Neural Networks model. 2 different Neural nodes were used to combine the results and reach the target score.

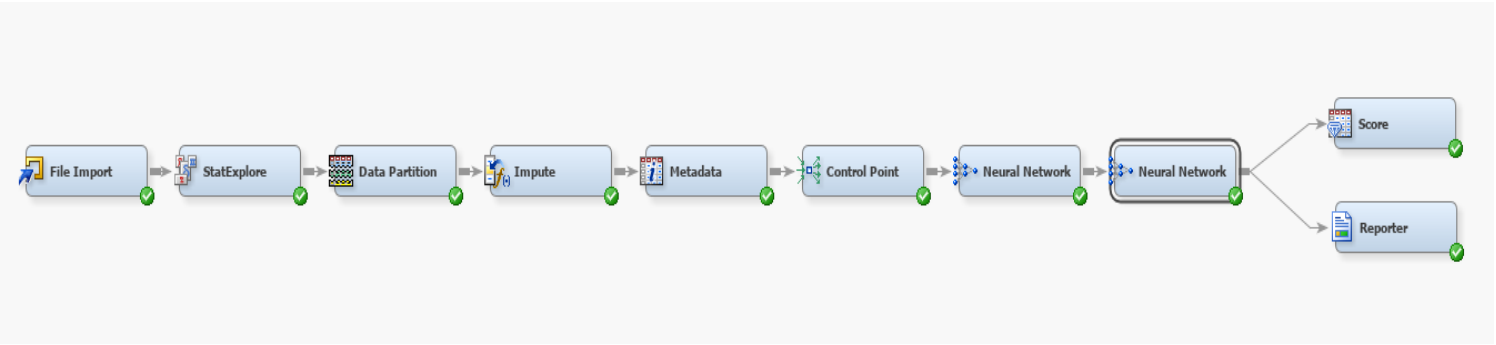


FIGURE 25. THE FINAL ARTIFICIAL NEURAL NETWORK MODEL

Each neural network contained 12 and 3 hidden layers separately. The formulation worked well. So that, the most accurate model with the given dataset was built.

As 2 different Neural Networks have been integrated, the weights were calculated accordingly. With the aid of that, the model made a good understanding of the weights of nodes. The related arrows repeated the iterations until the model finds adequate weight and accuracy.

TABLE 6. THE MISCLASSIFICATION RATE OF THE FINAL ANNS MODEL

Misclassification Rate	0.119852	0.115197	0.117731
Root Final Prediction Error	0.06769	.	.
Root Mean Squared Error	0.0676	0.06592	0.066709
Root Average Squared Error	0.067509	0.06592	0.066709
Average Error Function	0.023161	0.019558	0.020792
Final Prediction Error	0.004582	.	.
Mean Squared Error	0.00457	0.004345	0.00445
Average Squared Error	0.004558	0.004345	0.00445

The numbers of statics show the model success criteria within different segments. The arrangement of values is mandatory to be related to the purpose of the model. In the terms of the accuracy of any model, we have to consider and calculate the Misclassification Rate.

Table 6 shows the results for all phases of the model such as training, validation, and testing. Although the model has reached the maximum accuracy level during the validation phase (11.5%), the stage we have to measure is the testing.

The degree of misclassification of the model during the testing phase is 11.7% which means the model has an accuracy rate of 88.3%. Considering that the models above 60-65% are considered sufficient, we may say that our final ANNs model has been successfully tested and validated.

Until the best accuracy was handled, I used many different iterations and nodes for improving the total degree of accuracy.

In Figure 26. the results of data partition for initial targets are represented. The statistics show that the model had been used a different range of partitions for deciding on weights and feeding the networks.

SAS Miner assigns a node to the process flow diagram to contain two or more nodes of the same type. The relationship between imported data and data partition provides window contains a list of the ports that ensure learning algorithm for using dataset. As we saw, table 6 confirms the improvement of accuracy from the training to the validation steps.

Although the model had some incorrect arrangements at the start, it improved the values with the backpropagation method and reached the required degree of accuracy. The validation of the model was then confirmed and presented.

The individual variable of 'database system' was selected as an input in the final cycle of iteration of the model. Defining at least one target variable as an input, helped to increase the total degree of accuracy and to reduce the average of error functions.

After all, I compared the impact of given input variables to the adjusted outputs separately. The value of the attributes indicates the specific integrations to consider when targeting each outcome. It is useful to analyze the selected attributes and measure the degree-of-value statistics of the output variables.

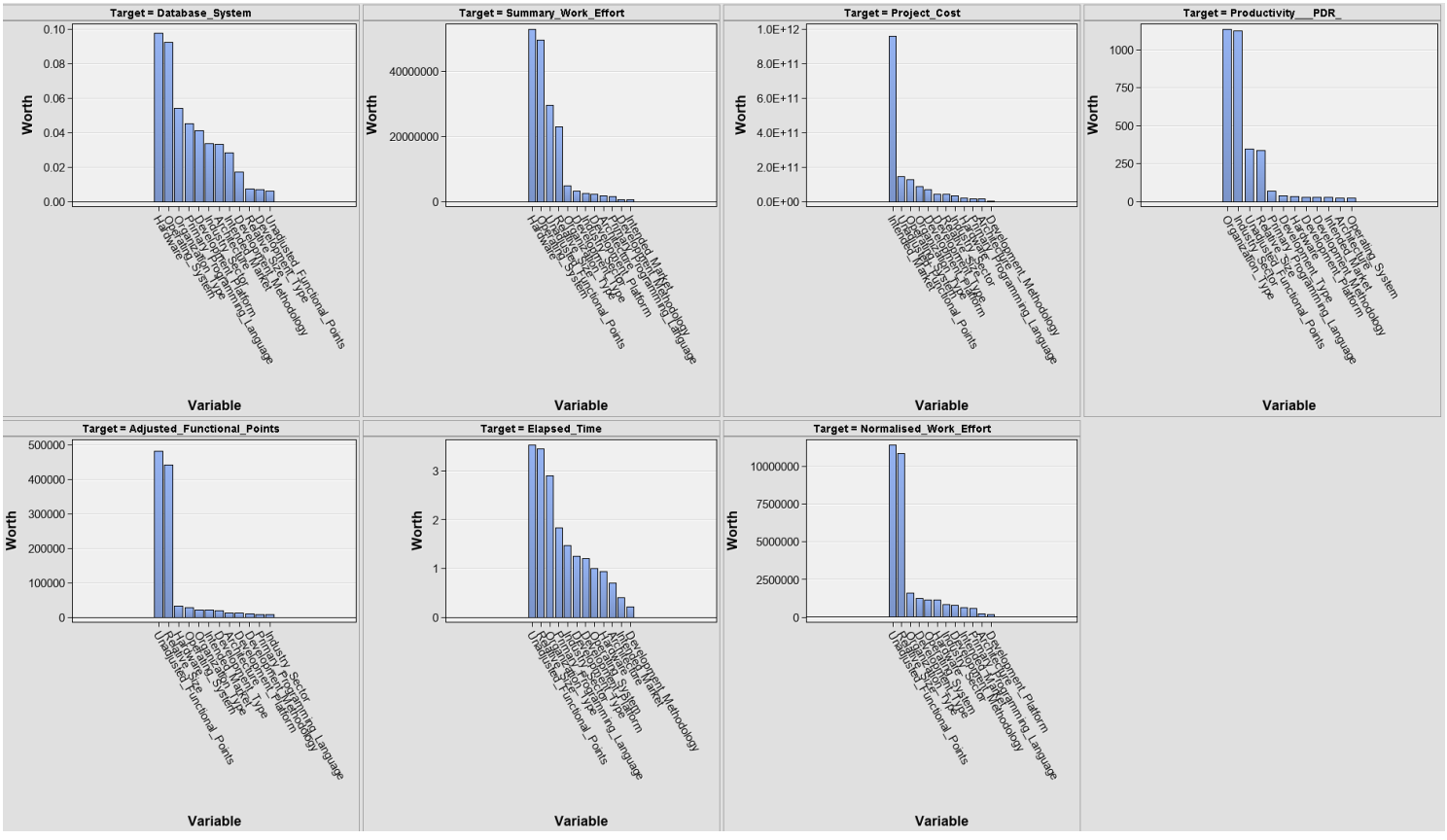


FIGURE 26. VARIABLES WORTH RESULT OF THE START EXPLORE

In figure 27. we may see the statistics of variable worth for all defined targets. With these results, it has been realized that which input plays the worth role in terms of the targets. The relative size of

the project is the most influential input of the model. This means the model evaluated this input node as the most impacted variable for a decision of total estimation. Apart from that, primary development language, organization type, and unadjusted function points are defined as the next valued variables.

4.5 DISCUSSION

The discussion of research aims to clarify the agreement of classification rate based on the accuracy level of the model. Taking into consideration that the models almost can't reach the maximum accuracy level, the result of about 65% or over is a satisfying output.

Selected variables helped to make the certain reasons for poor effort estimation that were referred to the research questions. Discussing and approving the result of the model, assisted to compare the model with other estimation techniques. When we look into the industry, we can say that the accuracy that the model achieved is sufficient.

It was an advantage to engage with the community, prioritize and analyze the results and validate the existed model. It has been discovered that if the model is not fitting well. it can cause a large number of errors. To use different models or neural networks with different architectures and then select the best one using the comparison node was the major point of model optimization.

With this discussion session, I made sure of the satisfaction rate and success levels for the developed Neural Networks model. The usage of different standardizations and transformations the most useful accuracy point was defined and applied.

Defined import data was used during the stage of model library and package creation. The developed diagram then referred to imported data. As a result, the model reached a particular level of accuracy with special integrations and connections.

As mentioned in the evaluation stage, the model achieved an accuracy of 88.3% at the end. This means that new types of datasets can be used in the structured architecture to find the final effort of the software project within the built-in variables. it's advantageous to use the set of data from the same source (ISBSG). Projects from other organizations and companies may need some corrections in the architecture of the model in order to keep the accuracy at a high level.

This is, probably, a consequence of the project segments and work structure of the collaborating teams. Most models in the industry, use data from the ISBSG to validate the model. To bring the desired model into existence, lots of integrations were used. I have discussed the most realistic outputs with the SAS Miner experts to confirm the results. The optimization and architecture of the network were approved.

5 CONCLUSION AND FUTURE WORK

Artificial Systems are not always able to achieve the value at the desired stage. Many unexpected scenarios can arise during the development process cycle. Therefore, it is quite difficult to achieve 100% accuracy in most ANN Systems. However, with the growth of modern technology techniques, we can observe that the ANNs achieve quite high accuracy in different research fields.

After Evaluation and Discussion of the proposed model, the section will continue with the future work with a conclusion and recommendations. Regarding the question "Why are the early-stage Software effort estimates rarely accurate?" I defined components of forecast used in the selection of variables. These variables allowed the model to train and find errors. With the help of the Backpropagation technique, the neurons tried to correct the errors once they occurred.

The weights and connections are defined and calculated by the architecture of the multilayer perceptron. Different hidden units, iterations, neural layers, and outputs were tried, and the model with the most accuracy was reached. These networks then were monitored with the decision, score, and reporter nodes.

5.1 SYNTHESIS OF THE DEVELOPED WORK

The research aimed to find the solution for the early-stage Software effort estimations with the aid of Artificial Neural Networks. The synthesis of the dissertation was the incorporation of ideas and artifacts that added value to research. These ideas made the data selection and model comparison suitably.

To incorporate major strengths and themes, in this section I will describe the main ideas of research that directly influenced the work developed.

Considering the related resources, I defined the dataset that is reliable to use, the platform on which the model will be built, and the architecture to be used in the development. Quality factors were evaluated and justified. The key features of Effort Estimation are compared and its historical background is explored.

I stayed on arguments that add value to research that allowed me to decide on the combination of variables during the model construction phase. I used the backpropagation method in configuration so that the model could learn from its errors until having the minimum error function and misclassification rate.

The training process of the developed model took approximately 2 hours. Within this time, the system defined the relevant weights and iterations. In the testing phase, the model is checked with different units until the best result is achieved.

5.2 Research Limitations

As a limited resource - time management is a phase that recording and controls time to enable the project manager to control the amount of time spent assumed each work package/activity. (Westland, a book review by R. Max Wideman. In J. Westland, The Project Management Life Cycle, 2007)

On the other side, nowadays applying ANNs algorithms for early predictions is a reputable approach that sometimes even serves humanity in wide matters. The experiments based on medical care (one of the most important areas of modern society) show that IT has an irreplaceable role in the creation of inclusion and diagnostics that encourage medical research to improve the standard of living of citizens and increase life expectancy worldwide. (Misgana Negassi, Rodrigo S.I, Simon H, · Arkadiusz M, Alexander R., 2020)

According to the research questions the affected causes for the poor effort estimation of Software projects, existing attributes were identified and used in the creation of the model. The expectation of the solution was then validated Artificial Neural Networks model built in SAS Miner.

5.3 Future Work

After a deep literature review and solid practical effort, the model is validated by reviewing statistics and classifying errors. In the light of it, we can say that the applied Artificial model has a satisfactory accuracy in effort estimation of Software Development Projects.

Furthermore, during the review of the model, lots of ways were used to analyze classification rates and the most useful architecture (with specific iterations and optimization) was selected to be implemented within the model. Throughout, while building the model, I contacted SAS Community to correct the errors as much as possible and validate the model. Thus, the major feedback was received and evaluated.

The model was aimed to classify the particular data carefully by using the various information set. The classification of proposed labels was executed and approved. After the approval main statistics were reviewed and represented.

My suggestion to researchers might be to continue with more complex datasets to provide more training details for the model. So that, the developed model can reach the highest level of accuracy. These improvements can provide valuable advances in the field. On the other hand, there is no special model that could be used in every project with the same degree of accuracy. Integrating different types of datasets from varied organizations as much as possible can be helpful for the model to be well-structured.

The training technique I used during the model validation phase was backpropagation. As future work, analysts can use distinct techniques to construct the Neural Networks. At this stage, the preliminary training can be activated and analyzed. The number of runs and iterations can be

selected and applied separately. Given that the use of hidden bias execution helps to improve the target layer activation functions, the randomization scale should also be defined.

In addition, other tools may be used in the model development process with different architectures and configurations to compare the results. SAS Miner Enterprise is just one of the most useful platforms in the field. Therefore, working the other way can also help to create a unique effort estimation model.

The field of Information Systems changes rapidly. The responsibility of developers is to reflect these changes immediately. For project managers, a well-defined project is the key to the success. Therefore, besides the expert judgments, the new software techniques are also able to bring value to the organizations in terms of SEE. The estimation of effort is not a new idea, as it is and has always been a part of PM while structuring the assigning of the activities. However, the implementation of Artificial Intelligence in the SEE is a streamlined area of research as it must always meet the requirements of modern Software Development Projects.

Henceforth, the field can be improved by the implementation of new Artificial techniques. AI rapidly expand its horizons and changes are affecting all technological areas. Since the continuity of Software Projects requires sustainability and regular attention, we hope that the development of new applications will yield more beneficial results.

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