



An Unified Approach for Process Quality Analysis and Control

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Abstract— *The process in a company finally results in product of the company, which represents the company standard. Hence, during the process execution time quality of the process needs to be taken care before and after the work done. In this paper, an unified approach to quality analysis and control of a process development is presented. This approach gives an overview of what the task the company assigned to the employers. The process is defined as the set of action items to achieve the work completion. Quality means grade of excellence. Quality analysis of a process is an improvement of the process and making sure that all the standard procedures are followed. An unified approach designed in this paper is a combination of software cost estimation and a financial market forecasting with the support of historical data, statistical data mining technique and artificial neural networks, which helps the developers as well as investors in strategic planning and investment decision making. Therefore, the paper describes a recommended process to develop software (SW) cost estimates for software managers, perform financial market forecasting to control quality of process development. As a result, the improvement and analysis of the process quality can be performed from basic level to the corporate level. By this work, we conclude that the process quality control can be made easier and efficient compared to the old graphical analytics technique.*

Keywords—*Process development, quality control, software cost estimation, financial prediction, artificial neural network*

I. INTRODUCTION

In Process Company, data historians continuously collect process data from most of the process variables through the whole process chain. Statistics has always been a very popular tool in the manufacturing enterprises for process and quality controls, as proposed in [12]. A combination of statistical, neural networks techniques and database technology is used for quality improvement, as proposed in this work.

Software cost estimation and financial analysis are normally carried out together. The costs of development are primarily the costs of the effort involved, so the effort computation is used in both the cost and the schedule estimate [9]. However, some cost estimation may have to do before detailed schedules are drawn up. These initial estimates may be used to establish a budget for the project or to set a price for the software for a customer. One could quote a vague figure called the 'accepted market rate' if the design and specifications were not finalized before the estimation began and then go on changing that figure [provided one had the skill set to do so] as and when the design and specs were finalized.

Cost estimation should never be an activity that is performed independently of technical work. In the early life-cycle phases, cost estimation is closely related to design activities, where the interaction between these activities is iterated many times as part of doing design trade studies and early risk analysis, as proposed in [8]. Later on in the life-cycle, cost estimation supports management activities is primarily detailed planning, scheduling, and risk management. The purpose of software cost estimation is to define the resources needed to produce, verify, and validate the software product, and manage these activities.

Financial analysis is designed to determine the relative strengths and weaknesses of a company. Investors need this information to estimate both future cash flows from the firm and the riskiness of those cash flows, as proposed in [11]. Financial managers need the information provided by analysis both to evaluate the firm's past performance and to map future plans. Financial analysis concentrates on financial statement analysis, which highlights the key aspects of a firm's operations.

Financial statement analysis involves a study of the relationships between income statement and balance sheet accounts, how these relationships change over time. Financial planning is a continuous process of directing and allocating financial resources to meet strategic goals and objectives. The output from financial planning takes the form of budgets. The most widely used form of budgets is Pro Forma or Budgeted Financial Statements. The foundation for Budgeted Financial Statements is Detail Budgets. Detail Budgets include sales forecasts, production forecasts, and other estimates in support of the Financial Plan. Collectively, all of these budgets are referred to as the Master Budget.

Each year, the field of computer science becomes more sophisticated as new types of technologies hit the market. Despite that, the problem of developing intelligent agents that will precisely simulate human brain activity is still unsolved. One of the most prominent models of intelligent agents built in computer memory is represented by neural networks, as

proposed in [16], along with the prediction pattern that can be successfully used in different types of "smart" applications. Specifically, a financial predictor based upon neural networks has been explored.

Artificial neural network (specifically feed-forward network) can predict future stock market prices used in this work. This "forecasting" capability makes them a perfect tool for several types of applications:

- Function interpolation and approximation
- Prediction of trends in numerical data
- Prediction of movements in financial markets

All the examples are actually very similar, because in mathematical terms, we are trying to define a prediction function $F(X_1, X_2, \dots, X_n)$, which according to the input data (vector $[X_1, X_2, \dots, X_n]$), is going to "guess" (interpolate) the output Y . The most exciting domain of prediction lies in the field of financial market. An investment strategy based on computer intelligence sounds like a very prominent and interesting field of study. Therefore, in this work we proposed a feed forward neural network that has trained with resilient propagation algorithm, which attempts to predict the future stock prices of S&P500, DOW, NASDAQ Composite indexes, and Prime Interest Rate, according to the input data which have been described shortly in implementation section.

II. RELATED WORK

Product quality must be the focus for any process. Statistical process control (SPC) methods have received growing interest in quality assurance to help and improve different processes, as proposed in [1]. Reference [1] had provided a SPC chart overview, statistical data analysis, and data mining techniques for designing SPC to improve manufacturing processes quality control.

Statistical process control (SPC) methods have received growing interest in the healthcare community to help improve clinical and administrative processes, as proposed in [2]. Reference [3] presented the methodology for the integration of control charts using data mining techniques to achieve process control. Software estimation is an important process for making high-quality management decisions in the software industry. The most important reason for the software project failure is inaccurate estimation of parameters in early stages of the project planning. So, the methods of estimation play an essential part in achieving the accurate and reliable estimates, as proposed in [4], [6] large body of experience with estimation models, the accuracy of these models is not satisfactory. Accurate estimation of software development effort is critical in software engineering. Underestimates lead to time pressures that may compromise full functional development and thorough testing of software. Hence, the quality assurance for the effort estimation is proposed in [10]. To assure this quality, the ISO 9126 quality factors are used. Software cost of estimation become a complicated branched science hence many functional sizing techniques, sizing metrics, cost and effort models appeared which probably not exist in the rest of sciences. Reference [7] revealed that the common techniques used highlight the most important trends in this field also it shows the urgent topics to be investigated and the challenges in SCE process. Reference [5] proposed software metrics provide a quantitative basis for the development and validation of methods utilized in software cost estimation process and can also be used to improve the productivity and quality of the process. In [15], computational data mining methodology was used to predict four major stock market indexes. Two learning algorithms including Linear Regression and Neural Network Standard Back Propagation (SBP) were tested and compared. Reference [13] had described data mining in financial application. Issues of this technique involved in specific financial applications are compared and discussed. Stock market price index prediction is a challenging task financial firm. To predict the future raise and fall of future price, data analysis is used, as proposed in [14]. In [17], back propagation neural networks (BPNN) are trained with standard steepest descent, heuristic and numerical techniques; and accuracy measures are computed for comparison purpose. It is found that numerical algorithm outperform heuristic techniques.

III. PROPOSED WORK

In this work, an integrated method of COCOMO and resilient algorithm has been proposed for improving the process development.

COCOMO: COCOMO is a simple on-line cost model for estimating the number of person-months required to develop software. The model also estimates the development schedule in months and produces an effort and schedule distribution by major phases. COCOMO is a widely spread model that combines statistical figures, mathematical equations, and expert judgment.

-COCOMO estimates are more objective and repeatable than estimates made by other methods.
- COCOMO can be calibrated to reflect your software development environment, and to produce more accurate estimates.

Resilient: Resilient Propagation (RPROP) is one of the best general purpose training methods provided for neural networks.. RPROP has been used for feed forward neural networks to estimate the future financial outcomes for a company or country (for futures and currency markets) with the help of historical internal accounting and sales data.

IV. SYSTEM DESIGN AND IMPLEMENTATION

A. System design:

System block diagram illustrates that cost estimation of software product is performed by using the historical data of a company database. The estimated cost of software product can be used for future cost estimation of other software products. The required software programs (application programs) are found for the development of the new software

product from the company systems before proceeding to the product development. This is achieved through the software finder block as shown in Fig.1 with system catalog which represents the necessary activities provided for the development.

A completed software product is then ready for launch to the market. Meanwhile, the investors should have to forecast the future cost price of their developed product since successful stock price prediction could yield significant profit. The financial forecasting as shown in Fig.1 below has been done with the help of huge historical data of many company databases and resilient propagation algorithm. The historical stock market price data of the four leading stock market indices currently traded in U.S stock market exchanges, is used. The result would be the accurate and efficient one, which represents the probable cost of product and helps the developers as well as investors to make strategic and financial decision.

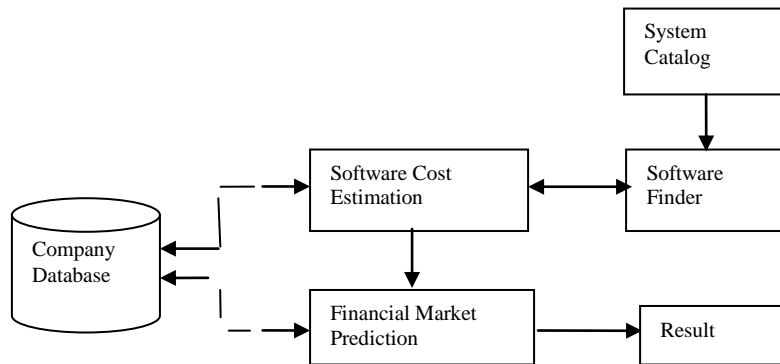


Fig.1. Block diagram of proposed system

B. Implementation:

The purpose of implementing the proposed system is to improve the process development. As it is a process of estimating the cost and financial forecasting, COCOMO and Resilient algorithm played a vital role in process quality improvement.

The proposed work is implemented in .Net framework using C# language. Software cost estimation is done using COCOMO model and FPA (function point analysis) with the formula as,

Delivered Source Instructions (KDSI)

$$\text{Programmer Effort (PM)} = 2.4 \times (\text{KDSI})^{1.05} \text{ in programmer-month}$$

$$\text{Development Time in month (TDEV)} = 2.5 \times (\text{PM})^{0.38} \text{ in months/weeks}$$

The general approach of FPA is:

- Determine and count five information domain characteristics: inputs, outputs, inquiries, files, and external interfaces as shown in Table 1.
- Compute the Function Points following the formula:

$$FP = \sum UFP \times [0.65 + 0.01 \times \sum(F_i)]$$
, which F_i are “complexity adjustment values” as shown in Table 2 based on responses to some questions.
- Calculate the Source Lines of Code with the help of Language Factor

$$\text{Source Lines of Code (SLOC)} = FP \times LF$$

TABLE I. Information domain characteristics

Function Type	Simple	Average	Complex
Inputs	×3	×4	×6
Outputs	×4	×5	×7
Inquires	×3	×4	×6
Files	×7	×10	×15
External Interfaces	×5	×7	×10

TABLE II. Complexity weighting factors

Complexity Weighting Factor	Value(0-5)
Backup and recovery	
Data communications	
Distributed Processing	
Performance Critical	
Existing operating environment	
On-line data entry	
Input transaction over multiple screens	
Master files updated online	
Information domain values complex	
Internal processing complex	
Code designed for reuse	
Conversion installation in design	
Multiple installations	
Application designed for change	

In this work, we implemented the financial future stock market indices in .Net framework using C# language.

V. RESULTS AND DISCUSSIONS

The results have been obtained through the analysis of the proposed work are as follows,

The final cost of the project is obtained by using the algorithmic model called COCOMO (Constructive Cost Model) model as shown in Fig. 2. It estimates a development time, final cost and programmer's effort spent for each type of project.

The window running form consists of size metrics like function point calculation, Unadjusted function point and source line of code, which are needed for estimating the project cost. Total development time in months and programmers effort in persons-month is used as a function of program size for estimating the final cost of the project. The window form also consists of a graph that represents the statistical data analysis of the cost estimation process.

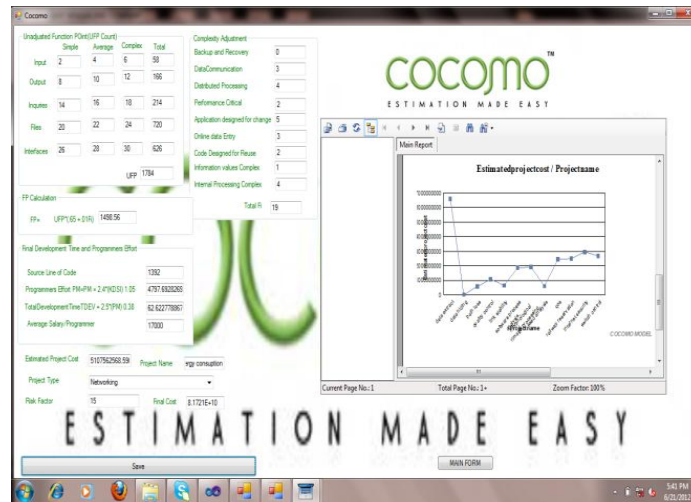


Fig.2 Estimation of final cost of a project with the help of COCOMO model and historical data

Fig. 3 is a financial prediction window running form, which is implemented using C#.Net platform in Microsoft visual studio where historical data of four stock market indices like DOW Jones, NASDAQ, S&P100 and Prime Interest Rates are fed into the neural network for predicting their future price values in financial market. Fig.3 actually shows the training of neural network when the data as input of all the stock market indices are fed into the feed forward neural network. The network is trained from January 1990 to January 2010.

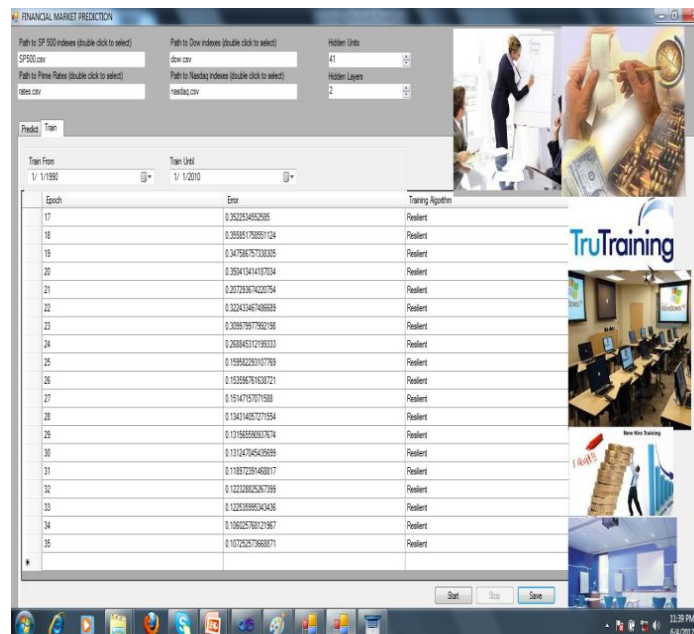


Fig.3 Training of neural network on Inputs as stock prices of four stock market indices

Fig. 4 shows actual and predicted stock price values of S&P100, NASDAQ, and DOW Jones from JAN 1990 to JAN 2010 in financial markets.

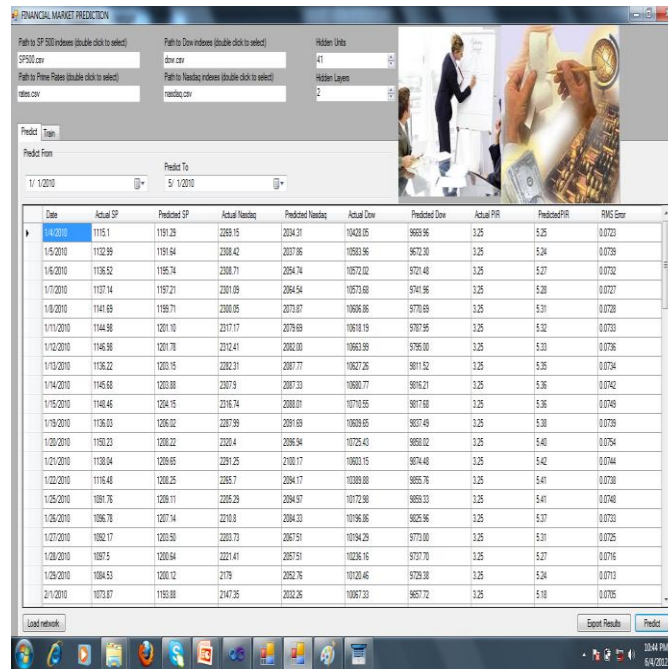


Fig. 4 Result of the actual and the predicted stock price values of four indices

Four outputs correspond to each of indexes on the input (S&P500, DOW, NASDAQ Composite, and Prime Interest Rate). The neural network job is to find hidden patterns in the input data which influences the overall output. After training the network using 40-41-41-4 topology (40 input units, 2 hidden layers with 41 units, 4 outputs), and trying to predict the values, the following graphs shown in Fig.5 have been obtained:

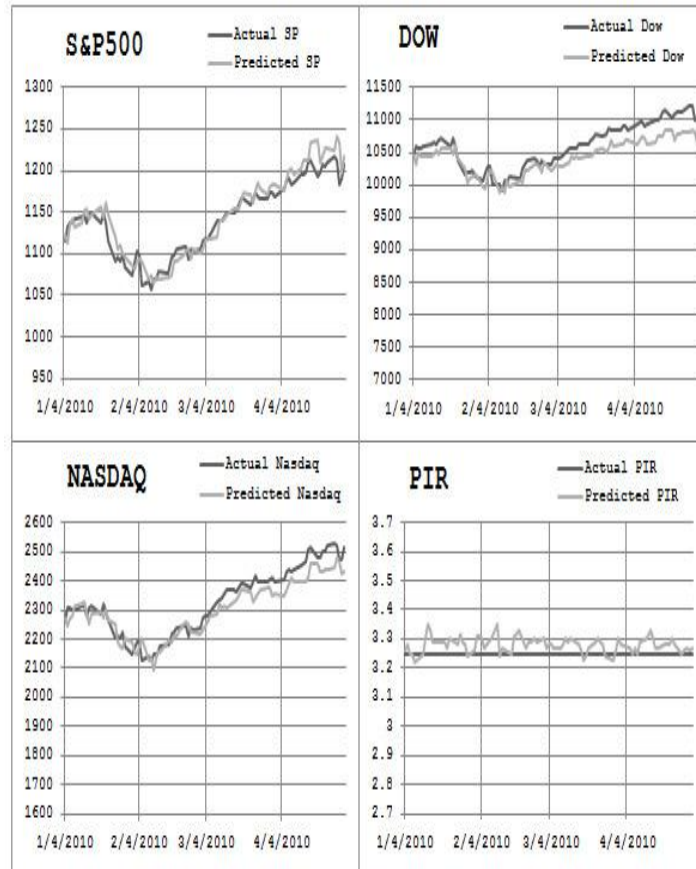


Fig 5 Actual vs. predicted stock price values of four stock market indices

VI. CONCLUSION AND FUTURE WORK

In this work, the software development process cost estimation and financial predictor using neural networks and their prediction capabilities have been analyzed. Feed forward neural networks proved to be a reliable solution for applications that need to predict something. To estimate the effort needed for the software project, Function Point Analysis (FPA) and COCOMO model are used to predict the size and cost of developing the ESTMD system. The present work has been developed which can be the statistical analysis of software process quality control. The future work can be done which can be the dynamic analysis of the process quality control.

The future work can also be done for the in-built verification and debugging, generation of human auditing report that shows the examination of records to check its accuracy and for developing a GUI based human interactive system by using biometrics which is a technology that measure and analyse human body characteristics such as DNA, Fingerprints, Eye retinas, Voice patterns for authentication purposes.

REFERENCES

- [1] Dr. Amir Mohamed Kamal, "A data mining approach for improving manufacturing processes quality control", Information Technology Department College of Applied Sciences Ministry of High Education Irbil, Sultanate of Oman, www.ibri.cas.edu.om, *IEEE Press*, 2011
- [2] James C. Benneyan, "Design, use, and performance of statistical control charts for clinical process improvement", North-eastern University, Boston MA, September 16, 2001.
- [3] E.V.Ramana and P. Ravinder Reddy, "Integration of control charts and data mining for process control and quality improvement", Dep't. Of Mech. Engg, Shadan College of Engineering & Technology, Hyderabad, India Deptt. of Mech. Engg., Chaitanya Bharati Institute of Technology, Hyderabad, India, *International Journal of Advances in Engineering & Technology*, Jan 2012.
- [4] Hareton Leung, Zhang Fan, "Software cost estimation", Department of Computing, The Hong Kong Polytechnic University.
- [5] Malathi Research Scholar, "Analysis Of size metrics and effort performance criterion in software cost estimations", Department of Computer Science, Sathyabama University, Dr .S .Sridhar Research Supervisor, Department of CSE & IT, *Indian Journal of Computer Science and Engineering (IJCSE)*, FEB 2012
- [6] V. Ferens, and R. B. Gumer, "An evaluation of three function point models of estimation of software effort", *IEEE National Aerospace and Electronics Conference*, vol. 2, 1992, pp. 625-642. Y.
- [7] Abedallah Zaid, Mohd Hasan Selamat, Abdul Azim Abd Ghani, Rodziah Atan and Tieng Wei Koh, "Issues in software cost estimation" .University Putra Malaysia, UPM Serdang 43400, Selangor Darul Ehsan, Malaysia, *IJCSNS International Journal of Computer Science and Network Security*, 350 VOL.8 No.11, November 2008
- [8] Hoang Pham and Xuemei Zhang, "A software cost model with warranty and risk costs", *IEEE Trans. software Eng.*, vol. 48, no. 1, pp. 71-75, Jan 1999.
- [9] Ayman A. Issa, "An algorithmic software cost estimation model for early stages of software development", *International Journal of Academic Research*, Vol. 3. No. 2. 2011
- [10] H. Azath and R. S. D. Wahidabanu, "Function point: a quality loom for the effort assessment of software systems", King College of Technology, Namakkal, Tamil Nadu, Government College of Engineering, Salem, Tamil Nadu, India, *IJCSNS International Journal of Computer Science and Network Security*, VOL.8 No.12, December 2008 321
- [11] George T. Fried lob, Lydia L.F., Schleifer, "*Essentials of financial analysis*", Handbook new jersey, Canada, 2003
- [12] Box, G. E. P., Jenkins, G. M. (1994), "*Time series analysis: Forecasting and control*", (3rded.). Englewood Cliffs: Prentice Hall.
- [13] Dongsong Zhang and Lina Zhou, "Discovering Golden Nuggets: Data mining in financial application" *IEEE transactions on systems, man, and cybernetics*—part c: applications and reviews, vol. 34, no. 4, November 2004
- [14] K. Senthamarai Kannan, P. Sailpathi Sekar, M.Mohamed Sathik and P. Arumugam, "Financial stock market forecast using data mining techniques", *International multiconference engineers and computer scientists*, 2010
- [15] Dr. Wilton.W.T. Fok, IAENG, Vincent.W.L. Tam, Hon Ng, "Computational neural network for global stock indexes prediction", Proceedings of the World Congress on Engineering, 2008, Vol II WCE 2008, July 2 - 4, 2008, London, U.K.
- [16] C. Ornes and J. Sklansky, "A neural network that explains as well as predicts financial market behavior", *Proc. IEEE IAFE*, New York, Mar. 24–25, 1997, pp. 43–49.
- [17] Salim Lahmiri, "A comparative study of back propagation algorithms in financial prediction", Department of Computer Engineering, University of Quebec at Montreal, Montreal, Canada, *International Journal of Computer Science, Engineering and Applications (IJCSEA)* Vol.1, No.4, August 2011