Performing High-Accuracy & Effective Remote Infrastructure Management using ANN

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Abstract
Remote Infrastructure Management (RIM) involves a combination of near-shore and offshore delivery models. RIM can reduce the costs of operations, thus enabling IT managers to consider investing in new technology. Matching IT infrastructure with the needs of a business is a CIO’s biggest challenge. The increasing complexity of IT infrastructure and the constant pressure to reduce its costs, forces CIOs to maximize the use of existing resources and to enhance productivity of key technical people. Downtime, however brief, can result in revenue losses, unhappy customers and a loss of productivity. Instead of using productive time to making strategic decisions, key personnel are forced to spend it in routine management of IT infrastructure. The objective of this paper is focused on Artificial Neural Networks (ANN) based system to verify whether a RIM will ultimately lead to improvement in Software Process. Predicting success or failure of RIM & achieving maximum accuracy by changing number of neurons in ANN system is one of the main conclusion.

Keywords
Artificial Neural Networks (ANN), Remote Infrastructure Management (RIM), Network Operations Centers (NOC), Classification Matrix (CM) etc

I. Introduction
Remote Infrastructure Management Services provide for monitoring and management of all infrastructures pertaining to networks, data centers, servers, storage security, Applications and End user computing, outside the company’s offices.

II. Governance in RIM
The ability of organizations to exploit IT infrastructure, operations and management Sourcing/service solutions not only depends on the availability, cost and effectiveness of applications and services, but also with coming to terms with solution providers, and managing the entire sourcing process. In the rush to reduce costs, increase IT quality and increase competitiveness by way of selective IT sourcing and services, many organizations do not consider the management side of the equation.

III. Key Action Steps in RIM Outsourcing
A. Growing need for High Availability
Almost every aspect of today’s business environment has come to rely on the uninterrupted availability of platforms, applications, and data. From customer relationship management and enterprise resource planning, to employee communication and collaboration, a failed application or system can be costly and disruptive. The impact of downtime continues to grow as companies move toward a real-time business model supported by a Services Oriented Infrastructure. Achieving high service availability to meet growing needs requires a combination of people, processes, and technology, including: highly reliable platforms, extensive hardware and software testing, rigorous change management, highly trained staff and well established emergency procedures.
B. Focus on Service Delivery

The business value of an application depends on the ability of end-users to access and use the application, as well as any broader service. That service may depend on multiple applications, servers, networks, etc., and these relationships must be considered in assessing availability requirements. Service Level Agreements (SLAs) are the fundamental methods for measuring the performance of any group responsible for delivering services. Developing the right SLA is important. And, having the right baseline measures in place before negotiating the handoff is critically important. You cannot expect the service provider to deliver on something your organization was incapable of delivering unless they have the same degree of opportunity.

C. Retaining your Intellectual Property

One of the basic fears in outsourcing is that over time you lose a great deal of intellectual capital. Knowledge of networks and systems is important to every enterprise. Just because you outsource does not mean that the knowledge should go with the transaction. Make governance a deliberate process and ensure that everything is well documented. Appoint a single point of contact from your side and make sure that person is working very closely with your service provider’s single point of contact.

IV. Objective

The objective of this work is to use ANN System for maximizing the accuracy of Remote infrastructure management & reduce cost, time, other resources for its effective implementation. ANN based system in this research work is very useful for improvement in software process & predict its success or failure.

V. Literature Survey

According to IDRBI [7], The pace of business is accelerating around the globe, as leading organizations in computer intensive industries, such as financial, trading, manufacturing and retail industries move toward a real Time business model in which transactions and information sharing are near-instantaneous. For long, it was the understanding that IT infrastructure meant the hardware and software, and if at all, the related network. Managing it meant procuring and installing them. The rapid pace of competition and growth compelled the organisations to do ‘vertical thinking’, and consequently the organizations built both forward and backward linkages to this core IT infrastructure. Today, the IT Infrastructure has been redefined and its meaning has been extended much beyond and before the procurement function. It starts from where it should – the IT policy and strategy, the plan and the design of IT architecture, the business process of procurement, installation and management of h/w, s/w, n/w and other related equipments, tools and facilities, IT personnel and expertise, IT security arrangements and administration, IS audit, application development, integration and management, vendor management and on and on. Further, today’s IT infrastructure has become pervasive in these organizations.

It encompasses front, back and middle offices, covers customers, suppliers, employees and partners, and permeates every type of operations like strategizing, planning, manufacturing, servicing, etc. In the process, mission critical business processes heavily depend on the IT infrastructure. Yet another development is that this IT infrastructure is getting increasingly complex and specialized, compelling the institutions to develop expertise and specialties in these areas. This transition is putting increasing demands on the performance, capacity, availability, and agility of underlying IT infrastructure. As process timelines are compressed from weeks or days, to hours, minutes or even seconds, the cost of downtime skyrocket. From supplier and customer transactions, to employee communications and financial reporting, business-critical functions must be up and running at all times. Business availability and continuity is critically poised on and directly correlated to and depends on the capacity, availability and reliability of the IT Infrastructure. Therefore, the management of such a massive and complex infrastructure has become the current focus of discussions in many forums, including this one.

Today’s organizations understand the link from the availability and performance of the IT infrastructure to the availability and performance of business processes as a whole. The management of the IT infrastructure has a significant impact on the success or failure of the business, directly affects the quality of service of business applications, and contributes to the satisfaction of internal and external users. Business units are asking more of IT and systems is important to every enterprise. Just because you outsource does not mean that the knowledge should go with the transaction. Make governance a deliberate process and ensure that everything is well documented. Appoint a single point of contact from your side and make sure that person is working very closely with your service provider’s single point of contact.

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Today’s organizations understand the link from the availability and performance of the IT infrastructure to the availability and performance of business processes as a whole. The management of the IT infrastructure has a significant impact on the success or failure of the business, directly affects the quality of service of business applications, and contributes to the satisfaction of internal and external users. Business units are asking more of IT organizations. The rate at which new demands are being placed on the IT infrastructure is outpacing the capacity of IT organizations to effectively manage and support them. The complexity of what to manage and how to manage is compounded by the sheer number of new managed objects, as well as the legacy objects that must be maintained. An organization’s infrastructure management should address the availability, fault and Performance management of its IT infrastructure. Infrastructure Management covers:

- Optimization of the IT infrastructure to meet business needs
- for high availability, reliability and scalability
- IT infrastructure monitoring and testing technologies that deliver service assurance
- Technologies needed to build business service views
• Capacity-planning processes and best practices
• Enterprise Customer Relationship Management
• Managed services including Business Processes Management and Hosted Services

VI. Methodology
Neural networks have proved themselves as proficient classifiers and are particularly well suited for addressing non-linear problems. Neural networks process information in a similar way the human brain does. The network is composed of a large number of highly interconnected processing elements (neurons) working in parallel to solve a specific problem. Neural networks learn by example. They cannot be programmed to perform a specific task. The examples must be selected carefully otherwise useful time is wasted or even worse the network might be functioning incorrectly. Given the non-linear nature of real world phenomena, like predicting success of RIM, neural networks is certainly a good candidate for solving the problem. The six characteristics will act as inputs to a neural network and the prediction of success will be the target. Given an input, which constitutes the six measured values for the parameters of the matrix, the neural network is expected to identify if the RIM process will produce success or not. This is achieved by presenting previously recorded RIM parameters to a neural network and then tuning it to produce the desired target outputs. This process is called neural network training. The samples will be divided into training, validation and test sets. The training set is used to teach the network. Training continues as long as the network continues improving on the validation set. The test set provides a completely independent measure of network accuracy. The trained neural network will be tested with the testing samples. The network response will be compared against the desired target response to build the classification matrix which will provide a comprehensive picture of a system performance.

VII. Results
The results of this work are in the form of graphs of performance vs number of epochs by changing the number of neuron.

A. Percentage accuracy using single neuron used to construct ANN
Following graph plots the percentage accuracy achieved when 1 neuron was used to construct the artificial neural network.

It can be seen from the graph that ANN characteristics are
TRAINLM-calcjx, Epoch 0/100, MSE 0.304977/0, Gradient 0.301833/1e-010
TRAINLM-calcjx, Epoch 11/100, MSE 1.6714e-005/0, Gradient 0.000339815/1e-010
TRAINLM, Validation stop.
Total testing samples: 113
cm = 76 1
1 33
cm_p = 67.2566 2.6549
0.8850 29.2035
Percentage Correct Failure Detection : 96.460177%
Percentage Incorrect Failure Detection : 3.539823%

B. Percentage accuracy using two neurons used to construct ANN
Following graph plots the percentage accuracy achieved when 2 neurons were used to construct the artificial neural network.

It can be seen from the graph that ANN characteristics are
TRAINLM-calcjx, Epoch 0/100, MSE 0.304977/0, Gradient 0.301833/1e-010
TRAINLM-calcjx, Epoch 11/100, MSE 1.6714e-005/0, Gradient 0.000339815/1e-010
TRAINLM, Validation stop.
Total testing samples: 113
cm = 76 1
1 33
cm_p = 67.2566 2.6549
0.8850 29.2035
Percentage Correct Failure Detection : 96.460177%
Percentage Incorrect Failure Detection : 3.539823%

C. Percentage accuracy using three neurons used to construct ANN
Following graph plots the percentage accuracy achieved when 3 neurons were used to construct the artificial neural network.

It can be seen from the graph that ANN characteristics are
TRAINLM-calcjx, Epoch 0/100, MSE 0.259294/0, Gradient 0.204606/1e-10
TRAINLM-calcjx, Epoch 10/100, MSE 0.00290391/0, Gradient 0.0018924/1e-10
TRAINLM, Validation stop.
Total testing samples: 113
cm = 72 1
0 40
cm_p = 63.7168 0.8850
0 35.3982
Percentage Correct Failure Detection : 99.115044%
Percentage Incorrect Failure Detection : 0.884956%

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D. Percentage accuracy using 4 neurons used to construct ANN

Following graph plots the percentage accuracy achieved when 4 neurons were used to construct the artificial neural network.

It can be seen from the graph that ANN characteristics are:

- TRAINLM-calcjx, Epoch 0/100, MSE 0.59436/0, Gradient 0.943168/1e-010
- TRAINLM-calcjx, Epoch 14/100, MSE 0.00142662/0, Gradient 0.00174591/1e-010

Training stopped.

Total testing samples: 113

\( cm = 73 \ 4 \ 234 \)

\( cm_p = 64.6018 \ 3.5398 \ 0.8850 \ 30.9735 \)

Percentage Correct Failure Detection : 95.575221%
Percentage Incorrect Failure Detection : 4.424779%

E. Percentage accuracy using 5 neurons used to construct ANN

Following graph plots the percentage accuracy achieved when 5 neurons were used to construct the artificial neural network.

It can be seen from the graph that ANN characteristics are:

- TRAINLM-calcjx, Epoch 0/100, MSE 0.413338/0, Gradient 1.05106/1e-010
- TRAINLM-calcjx, Epoch 12/100, MSE 6.32562e-006/0, Gradient 0.000591805/1e-010

Training stopped.

Total testing samples: 113

\( cm = 70 \ 0 \ 142 \)

\( cm_p = 61.9469 \ 0 \ 8850 \ 37.1681 \)

Percentage Correct Failure Detection : 99.115044%
Percentage Incorrect Failure Detection : 0.884956%

F. Percentage accuracy using 6 neurons used to construct ANN

Following graph plots the percentage accuracy achieved when 6 neurons were used to construct the artificial neural network.

It can be seen from the graph that ANN characteristics are:

- TRAINLM-calcjx, Epoch 0/100, MSE 0.204106/0, Gradient 0.483386/1e-010
- TRAINLM-calcjx, Epoch 14/100, MSE 6.32562e-006/0, Gradient 0.000591805/1e-010

Training stopped.

Total testing samples: 113

\( cm = 74 \ 3 \)

\( cm_p = 65.4867 \ 2.6549 \ 1.7699 \ 30.0885 \)

Percentage Correct Failure Detection : 95.575221%
Percentage Incorrect Failure Detection : 4.424779%

G. Percentage accuracy using 7 neurons used to construct ANN

Following graph plots the percentage accuracy achieved when 7 neurons were used to construct the artificial neural network.

It can be seen from the graph that ANN characteristics are:

- TRAINLM-calcjx, Epoch 0/100, MSE 0.637532/0, Gradient 1.05106/1e-010
- TRAINLM-calcjx, Epoch 14/100, MSE 6.32562e-006/0, Gradient 0.000591805/1e-010

Training stopped.

Total testing samples: 113

\( cm = 74 \ 3 \)

\( cm_p = 65.4867 \ 2.6549 \ 1.7699 \ 30.0885 \)

Percentage Correct Failure Detection : 95.575221%
Percentage Incorrect Failure Detection : 4.424779%
H. Percentage accuracy using 8 neurons used to construct ANN

Following graph plots the percentage accuracy achieved when 8 neurons were used to construct the artificial neural network.

It can be seen from the graph that ANN characteristics are:

TRAINLM-calcjx, Epoch 0/100, MSE 0.408744/0, Gradient 1.36519/1e-010
RAINLM-calcjx, Epoch 9/100, MSE 4.07321e-007/0, Gradient 0.00281479/1e-010
RAINLM, Validation stop.
Total testing samples: 113
cm = 64.5  0.44
cm_p = 56.6372 4.4248  0.389381
Percentage Correct Failure Detection : 95.575221%
Percentage Incorrect Failure Detection : 4.424779%

I. Percentage accuracy using 9 neurons used to construct ANN

Following graph plots the percentage accuracy achieved when 9 neurons were used to construct the artificial neural network.

It can be seen from the graph that ANN characteristics are:

TRAINLM-calcjx, Epoch 9/100, MSE 0.40629/0, Gradient 1.42069/1e-010
RAINLM-calcjx, Epoch 15/100, MSE 0.00169697/0, Gradient 0.00633802/1e-010
RAINLM, Validation stop.
Total testing samples: 113
cm = 72.2  0.39
cm_p = 63.7168 1.7699  0.345133
Percentage Correct Failure Detection : 98.230088%
Percentage Incorrect Failure Detection : 1.769912%
Following graph plots the percentage accuracy achieved by varying number of neurons used to construct the artificial neural network.
It is evident that maximum 3 neurons are required to give the best result.

VIII. Conclusion

Thus it can be concluded from this paper that ANN with 3 neurons is ideally suitable for predicting failure of RIM & it can achieve 98% accuracy. Due to vast changes in IT Infrastructure & technologies, ANN is useful to predict success or failure of RIM. Neural networks have proved themselves as proficient classifiers and are particularly well suited for addressing non-linear problems. Given the non-linear nature of real world phenomena, like predicting success of RIM, neural networks is certainly a good candidate for solving the problem.

References


Sanjay P. Sood has a Ph.D. in Information Technology and his rich experience (17+ years) spans various geographies. Sood has pioneered eHealth / telemedicine in India, Benin and Mauritius. He has been a Consultant to the World Health Organisation. For over two years he was the healthcare technology consultant for World Bank’s Punjab Healthcare Systems project (USD 95 million) at Chandigarh, India. He has been an eHealth specialist on the panel of United Nations (UN Office for Outer Space Affairs, Vienna). He was the project manager / investigator for a USD 1.5 million India’s national pilot project (1999-2004) that lead to the first ever implementation of Telemedicine in India’s government owned hospitals. Sood set up C-DAC’s operations in Mauritius and was the Director, C-DAC’s operations in Mauritius for over four years (2004-2008). Till March 2011, Sood was working as the program manager (Healthcare IT) and was also heading Academic and Consulting Services Division at Centre for Development of Advanced Computing (C-DAC) Mohali and has also been the Project Manager/Co-investigator for three Govt. funded telemedicine Implementation Projects (amounting to over USD 3million) at Mohali in India. He managed and implemented large scale projects (implementation of two State-wide telemedicine networks) in Punjab & Himachal Pradesh. He has authored over sixty world-class articles and academic publications including five book chapters on cutting edge applications of IT in healthcare, he is serving on the editorial boards of six international journals on health informatics and technology management and is a technical reviewer for leading international journals, organizations and publishers (like IEEE, Wiley-USA, Elsevier-Netherlands). He is also a member of Healthcare Information & Management Systems Society’s (HIMSS) Global Task Force on Electronic Health Records, he also been a member of the Executive Council of International Society for Telemedicine and eHealth. Sood is a Life Member of Computer Society of India (CSI) and is the Management Committee member at the Chandigarh Chapter of CSI. Sood is a recipient of international scholarships (like Young Investigator Scholarship by University of Michigan, SIDA Scholarship), he has traveled to around 20 countries and his network includes global pioneers and leading international experts in the domain of IT. Presently, Sood is working as Head & Principal Consultant, State eGovernance Mission for National eGovernance Plan of Govt. of India in Chandigarh.

Er. Satinder Pal received his Master of Engineering from Punjab Engineering College, Chandigarh. He is having around 12 years of experience in Academia & Industry on senior positions. His research interests include Computer networks, Network security, ANN & Infrastructure Managed services with more than 20 publications – National & International.