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FPGA Implementation of NPSF Testing using Block Code Technique

By K.L.V Ramana Kumari, M. Asha Rani, N. Balaji & SK. Salaudeen

Abstract- This paper presents a test structure for high speed memories. Built in self test (BIST) give the solution for testing memories and associate hardware for test pattern generation and application for a variety of test algorithms. Memory test algorithm for neighborhood pattern sensitive faults (NPSF) is developed by using block code technique to identify the base cell and deleted neighborhood cells. Test pattern generation can be done by using LFSR and Euler pattern generation. The testing process is verified using Xilinx ISE 14.2 and implemented on Nexys 4 DDR Artix 7 FPGA board.

Keywords: LFSR pattern generation, euler pattern generation, block code technique, Nexys 4 DDR Artix 7 FPGA.

GJCST-G Classification: D.2.5



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FPGA Implementation of NPSF Testing using Block Code Technique

K.L.V Ramana Kumari ^α, M. Asha Rani ^σ, N. Balaji ^ρ & SK. Salaudeen ^ω

Abstract- This paper presents a test structure for high speed memories. Built in self test (BIST) give the solution for testing memories and associate hardware for test pattern generation and application for a variety of test algorithms. Memory test algorithm for neighborhood pattern sensitive faults (NPSF) is developed by using block code technique to identify the base cell and deleted neighborhood cells. Test pattern generation can be done by using LFSR and Euler pattern generation. The testing process is verified using Xilinx ISE 14.2 and implemented on Nexys 4 DDR Artix 7 FPGA board.

Keywords: LFSR pattern generation, euler pattern generation, block code technique, Nexys 4 DDR Artix 7 FPGA.

I. INTRODUCTION

Built in self test (BIST) design technique is a part of circuit which is used to test the circuit itself. Engineers design BISTs to satisfy demands such as lower repair cycle times or constraints such as limited technician accessibility and cost of testing during manufacture and high reliability. The main purpose of BIST is to reduce the test complexity, and thereby decrease the cost and reduce dependence upon external (pattern programmed) test equipment [1]. Built in self test techniques are very useful in testing of logic circuits, because they offer a cost effective way to test complex digital devices. First the BIST concept was implemented on combinational circuits, after that it found quick demands in the testing of regular structures like programmable logic arrays, read only memories, and random access memories.

Quick increment of multifaceted nature in the integrated circuits has prompt impact following on memory testing. On one view, the limit of random-access memories upgrades, in this manner expanding the test time and cost, on the other view, the complexity of memory circuits becomes more, and therefore more failure modes and faults should be considered in order to get a product with good quality [4]. Accordingly, different constraints need to take care while considering a test algorithm.

Minimizing the number of memory operations in order to allow large capacity memories to be tested in proper period of time and covering a larger collection of

memory faults. In the last previous days of memory design test procedures were developed in an ad-hoc manner. The fault coverage of these ad-hoc test procedures was limited and often indeterminable [2]. This shortcoming, acknowledged by most researchers, motivated the introduction of such fault models as stuck-at faults, decoder faults, coupling faults. If density of memory circuits increases, it increases coupling effects then the pattern sensitive fault PSF is becoming very important fault model [3].

The rest of the paper describes in the following way. Part 2 illustrates neighborhood pattern sensitive fault model to be covered. Part 3 illustrates the design of testing the memory using block code technique. Using a flow chart the operation of Block code technique is explained in detail. Part 4 illustrates the results and FPGA implementation of memory testing on Nexys 4 DDR Artix 7 FPGA board. Synthesis report is generated using XILINX. Part 5 gives the conclusion and future scope of the NPSF testing.

II. FAULTS IN MEMORY DESIGN

a) Memory structure

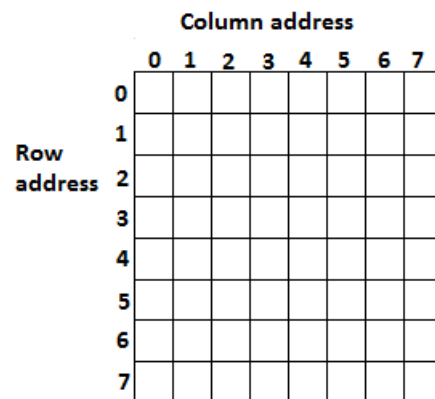


Fig. 1: 8*8 Memory structure

Fig 1 shows the memory structure of 8*8 RAM with 8 rows and 8 columns.

b) Neighborhoods Pattern Sensitive Faults

A Pattern Sensitive Fault is a restrictive coupling fault in which the content of a memory cell, or the capacity to change its content, is affected by a specific bit pattern in different cells in the memory. Here the

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information maintenance and change of the victim cell are influenced by an arrangement of aggressor cells. A neighborhood pattern sensitive Fault (NPSF) is a special instance of pattern sensitive faults [8], wherein the affecting (coupling) cells are in the neighborhood of the impacted (coupled) cell. The coupled cell is known as the base (or victim) cell and the coupling cells are known as the deleted neighborhood cells. The neighborhood incorporates 4 deleted neighborhoods and one base cell. It forms the coupling of these 4 cells with the base cell considering effect as the NPSF fault modeling.

c) *Active NPSF*

The base cell changes its contents because of changes in the deleted neighborhood pattern. To identify these affect, every cell must be read in state 0 and in state 1 for every single conceivable change in the deleted neighborhood pattern. There are two distinctive conceivable states for the base cell (0 and 1), N-1 methods for picking the deleted neighborhood cell which must experience one of two conceivable advances (↑ or ↓), and N-2 potential outcomes for the rest of the neighborhood cell contents.

$2 * (N-1) * 2 * 2N-2 = (N-1) * 2N$ is the aggregate number [8] of active neighborhood patterns (ANPs). It require 128 patterns for identifying active NPSF faults. For type-1 NPSF, 2 is base cell and 0, 1, 3 and 4 are deleted neighborhood cells.

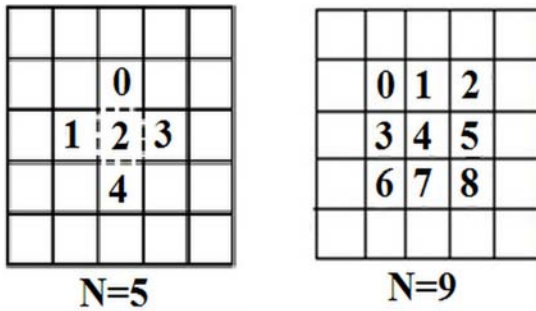


Fig. 2: Type-1 NPSF and TYPE-2 NPSF

Type-2 NPSF is used when diagonal couplings are significant. For type-2 NPSF, 4 is base cell and 0, 1, 2, 3, 5, 6, 7 and 8 are deleted neighborhood cells.

d) *Passive NPSF*

The content of the base cell can't be changed because of a specific neighborhood pattern. Every cell must be written and read in state 0 and in state 1 for all changes of the deleted neighborhood pattern. For each of the 2N-1 deleted neighborhood patterns, the two conceivable advances ↑ and ↓ must be confirmed. Subsequently, the aggregate number of PNPSFs is $2 * 2N - 1 = 2N$. Here N is number of cells. It require 32 test patterns for recognizing active NPSF faults.

e) *Static NPSF*

The content of a base cell is compelled to a specific state because of a specific neighborhood pattern. To distinguish these faults, apply the 2N combinations of 0s and 1s to the N-cell neighborhood, and check by perusing every cell that each pattern can be stored. It varies from ANPSF that it is not necessary to have a change to transition to sensitize an SNPSF. We required 32 test patterns for recognizing static NPSF faults.

III. MEMORY TESTING

a) *Block diagram of testing process*

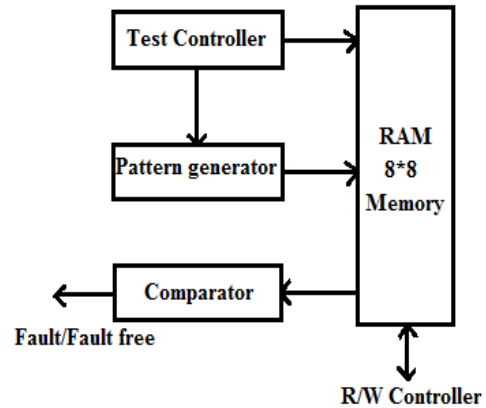


Fig. 3: Block diagram of memory testing

Fig 3 shows the testing process [12]. The pattern generator block generates the patterns for memory testing. These patterns are given as inputs to the deleted neighborhood cells of the selected base cell which are selected by the test controller. Then using the comparator we can find out the base cell content is changed or not. Deleted neighborhood cell and base cells are selected by using test controller, writing and reading of base cell can be done by using R/W controller.

b) Flow chart

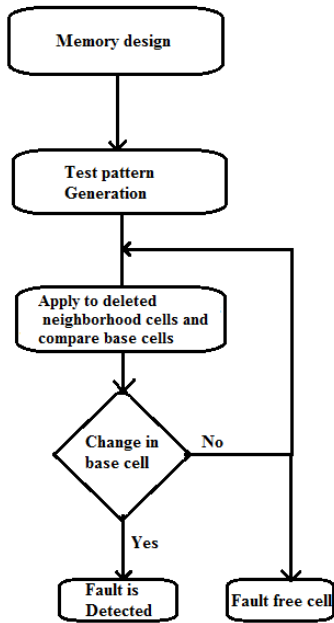


Fig. 4: Flow chart of Memory testing

The flow chart shown in Fig 4 represents the operation of memory testing. 8*8 memory design and testing can be done using Verilog HDL [7]. Generate the test patterns by using LFSR and Euler pattern techniques. Choose base cells according to the test cases and apply the test pattern to deleted neighborhood cells. Compare the content of base cells to test the fault.

Fig 5 shows that the memory is divided into nine different blocks. Nine test cases are used for testing the memory since maximum size of the block is 9. For test case 1 each block of first cell is selected as base cell then the base cells are selected as 00, 03, 06, 30, 33, 36, 60, 63, 66 and the pattern are applied to the deleted neighborhood cells of each base cell. For test case 2 each block of second cell is selected as base cell then the base cells are selected as 01, 04, 07, 31, 34, 37, 61, 64, and 67. Likewise for test case 9 the base cells are selected as 22, 25, 52 and 55.

00	01	02	03	04	05	06	07
10	11	12	13	14	15	16	17
20	21	22	23	24	25	26	27
30	31	32	33	34	35	36	37
40	41	42	43	44	45	46	47
50	51	52	53	54	55	56	57
60	61	62	63	64	65	66	67
70	71	72	73	74	75	76	77

Fig. 5: 8*8 memory divides into blocks

If base cell positions are not available in blocks then the base cells are chosen based on their availability [10]. Table 1 shows the base cells according to their respective test case.

c) Memory testing by using different test cases

Table 1: Base cell positions for test cases

S.NO.	TEST NUMBER	BASE CELL POSITIONS
1	TEST1	00,03,06,30,33,36,60,63,66
2	TEST2	01,04,07,31,34,37,61,64,67
3	TEST3	02,05,32,35,62,65
4	TEST4	10,13,16,40,43,46,70,73,76
5	TEST5	11,14,17,41,44,47,71,74,77
6	TEST6	12,15,42,45,72,75
7	TEST7	20,23,26,50,53,56
8	TEST8	21,24,27,51,54,57
9	TEST9	22,25,52,55

Table1 shows positions of base cells for detection of NPSF faults in memory. This table describes how base cells are selected for respective test cases.

d) Algorithm

Step 1: Write all base cells to 1.

Step 2: Applying pattern to neighborhood cells

Step 3: Read base cells

Step 4: Write all base cells to 0

Step 5: Read base cells

Step 6: Compare base cells if any change in base cell fault is detected.

e) Operation

During the 1st operation, cell 1 of each block will be selected as a base cell and the corresponding deleted neighborhood cells will be chosen accordingly shown in Fig 6. For test case 1 the base cell in 4th block is 30, the deleted neighborhood cell positions are 20, 31 and 40. During the 2nd test all the cells are in position 2 will be selected. For test case 2 the base cell in 5th block is 34, the deleted neighborhood cell positions are 24, 33, 44 and 35. Similarly for test case 9 the base cell in 5th block is 55, the deleted neighborhood cells are 45, 54, 65 and 56. Thus the entire memory can be tested after 9 independent test operations. The test patterns are applied to the deleted neighborhood cell and read the contents of base cell. If the content of base cell is changed then the NPSF fault can be identified for the particular pattern.

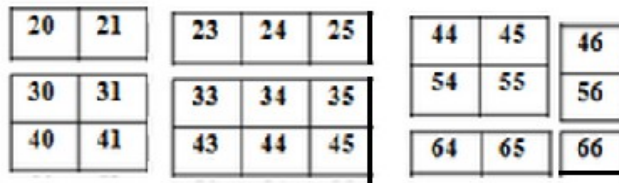


Fig. 6: Formation of deleted neighborhood cell

IV. RESULTS

a) *Modelsim Simulation*

The simulation results are shown for different test cases and different modes of operation.

i. *Memory testing for test case 2 write mode*

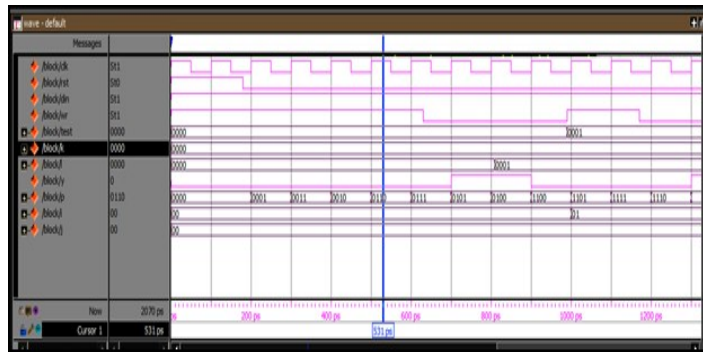


Fig. 7: Simulation output of test case 2 write mode

Fig 7 shows the simulation results of memory in test case 2. The wr signal controls the read, write operations. The binary representation of test case 2 for

memory testing is 0010. Whenever the “wr” signal is high all base cells are written in state 1 and pattern is applied to deleted neighborhood cells.

ii. *Memory testing for test case 2 read mode*

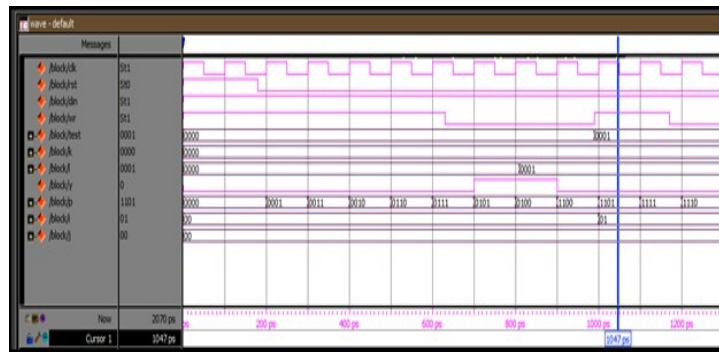


Fig. 8: Simulation output of test case 2 read mode

The fig 8 shows output result of read mode in the memory. Whenever “wr” signal is low it performs the

read operation, all the base cells are read from the memory.

iii. *Fault detection in memory*

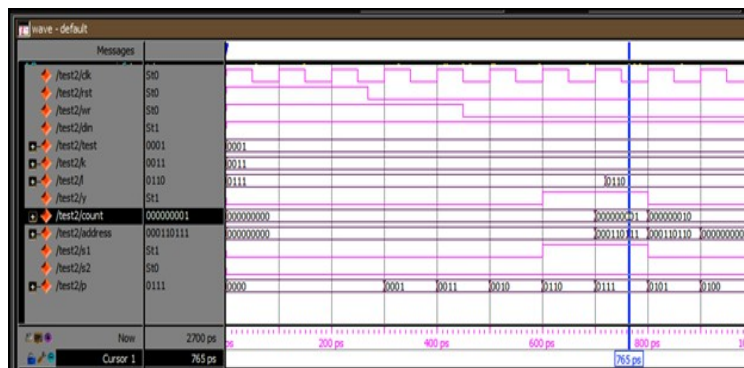


Fig. 9: Simulation output of fault detection in memory

Fig 9 shows the simulation results. Compare the contents of base cell with fault free memory in test case 0001. If base cell changes its contents then the error signal goes high, identified it as a fault and the address of the fault location also stored. Wherever the base cell changes the fault is detected and it shows the exact location of faulty base cell. All the NPSF faults are detected by using this technique and we applied all test cases for detecting NPSF faults in memory.

b) Xilinx Reports

Xilinx ISE is a software tool is used for synthesis and analysis of HDL designs [11]. Allows the developer to synthesize the design, gives timing analysis, RTL diagrams, and configure the target device with a programming kit.

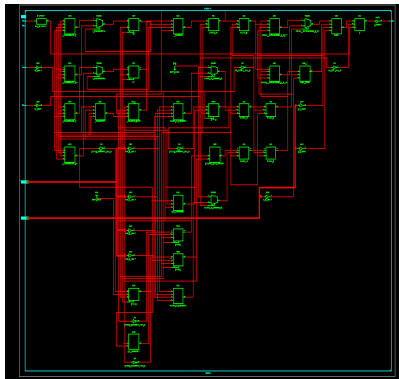


Fig. 10: Technological view

The RTL Schematic has been generated using XILINX 14.2 version. Fig 10 shows the RTL Schematic and technological view generated by using Xilinx. The Nexys4 DDR FPGA is optimized for high performance logic and offers 9,312 slices, each containing four input LUTs and eight flip-flops. Hence, the device facilitates the generated hardware to successfully fit into the available microcells.

c) FPGA Implementation

FPGA configuration files are transferred via JTAG port in bit file format. Xilinx's ISE Web Pack and EDK software can create bit file from Verilog. Nexys 4 DDR Artix 7 FPGA internal clock frequency is 100MHz; it has 16 LED outputs and 16 switches. The switches are used for giving the inputs and applying test cases. The output LEDs are used for showing the address of fault location in memory. The last LED is indicating detection of fault. If fault is detected then LED will ON otherwise it will OFF. The next 6 LEDs are showing the location of fault address.

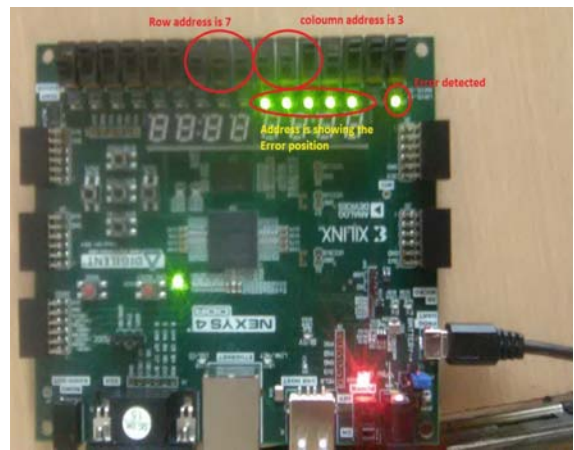


Fig. 11: Detecting fault in memory for test case 0001 with Nexysv4 DDR Artix 7 FPGA

The fig 11 shows the output of memory in reading base cells in test case 0001. The fault is detected by showing the LED glow and the faulty base cell coloumn address is 3and row address is 7. The six LEDs are indicating the location of faulty address.

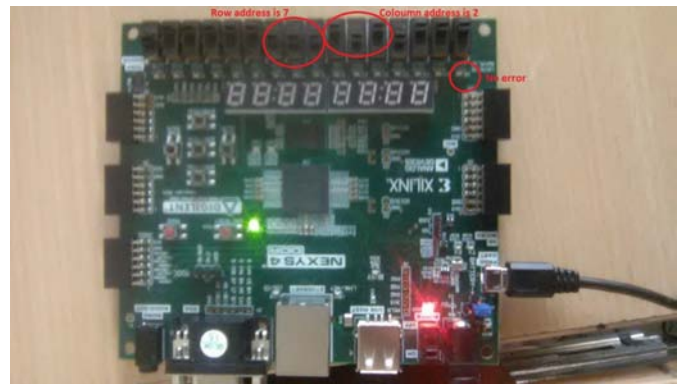


Fig. 12: Fault free condition of base cell in test case 0000

The fig 12 shows the output of fault detection in test case 0000. All base cells are compared and no faults are detected in test case 0000. So the fault signal remains low and not showing the address of the fault.

Table 2: Device utilization summary

SLICE LOGIC UTILIZATION	LFSR	Euler pattern
number of slices flip flops	44	44
number of 4-bit LUTs	32	31
Number used as logic	42	36
Number of occupied slices	42	36
Number of bonded IOBs	34	27
Number of slices contains only related logic	18	19
Number of full used LUT ff	50	42

The table 2 shows the summary of device utilization for Nexys 4 DDR Artix 7 FPGA. The utilization of device gives the information of number of LUTs, logic blocks and number of bonded IOBS used in FPGA, it can be obtained from synthesis report generated by Xilinx ISE.

V. CONCLUSION AND FUTURE SCOPE

For memory arrays, the excessive test algorithmic time associated with NPSF fault model. This paper presents a BIST implementation using block code technique to select base cells and deleted neighborhood cells of neighborhood pattern sensitive faults (NPSFs) in random access memories (RAMs). Testing process is synthesized and implemented on Nexys 4 DDR Artix 7 FPGA board. In order to improve the effectiveness of coupling faults, type-2 NPSFs can be modelled and tested.

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E-Governance Implementation: Challenges of Effective Service Delivery in Civil Service of Nepal

By Shailendra Giri, Subarna Shakya & Rose Nath Pande

Singhaniya University

Abstract- Civil servants are often charged not providing effective services though they have sufficient resources and technological knowhow. The authors is trying to explore the challenges of effective service delivery in civil service as implementing e-governance in Nepal. Survey method was used to generate data and adopted quantitative research technique. The study has claimed that Nepal has been facing numerous challenges during service delivery while implementing e-governance. Infrastructure development, human resource development and management, digital divide, are identified as the major challenges. Unnecessary influence of middleman and syndicate created by some hidden groups make government service holdup. Needless expansion of government agencies and its employees; too many layers in decision-making process; more process oriented service delivery rather than result oriented, failure to make individual officials responsible; and a lack of decentralization of necessary authority to the officials are the other challenges.

Keywords: *E-governance, e-government, civil service, service delivery, ICT, digital divide, good governance.*

GJCST-G Classification: *J.1*



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Shailendra Giri ^α, Subarna Shakya ^σ & Rose Nath Pande ^ρ

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Keywords: E-governance, e-government, civil service, service delivery, ICT, digital divide, good governance.

I. INTRODUCTION

E-governance helps to restructuring the way the Governments work, share data and information, connect citizens and deliver services using technology to external and internal clients for the benefit of both government and the clients that they provide. The government should try to apply e-government practices in all government bodies and public sector by promoting them technically, financially and officially. But the need of hour for government is to focus not only on software and hardware, but also to implement this strategy with honesty by government side. It's clear that, it's better to first create strong administration, to bring all government employees under confidence, only then we can think to bring e-governance. Connecting each and every person to this e-governed world and to provide basic facilities timely to the citizens while sitting at home [17].

The proper use of Information and Communication Technology (ICT) has made human life

and daily activities easy, fast and smart. The service delivery means of government, department and business organization has been economical, fast, efficient and reliable. The primary motive of government is to deliver public services transparently, accountably, effectively and efficiently. Civil service is one of the most important mechanisms for public service delivery by government side. The use of ICT for public service delivery can be more effective through integration, linkage and inter-operability system among government organizations, departments, business entities and other stake holders [12]. The perspective change is toward citizen oriented computerization rather than only back office computerization of existing system. Various modules were designed to help the citizens, like property taxation, water and electricity billing and accounting, various permits and smart licenses, death and birth registration, health scheme monitoring, municipal hospitals, e-bidding, budget, auditing, e-Sewa, online banking, e-ticketing, General administration & Establishment, legal matters, Citizen Help Desk, corporate websites etc [11].

E-governance has been essential to increase effectiveness, liability and to improve the service delivery and participation of the people in all aspect of government activities [18]. E-government is being deployed not only to make smooth civil services but also for public sector efficiency purposes. E-government has been a means of new governance with the use of ICTs to promote more efficient and cost effective government in present day world. It has facilitated towards more convenient government services, allowed greater public access to information, and made government more responsive to citizens through civil service [29]. E-government services aims to provide citizens with more accessible, accurate, real-time and high quality services and information [31]. It is a tool and techniques for the use of information and communication to improve and development of government activities and their social transformation [24] Implementation of E-Government could not imagine without the adoption of modern day technologies and applications [5]. It has been adopted as a new "paradigm shift" for better service delivery both by the developing countries and the developed countries [20].

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ICTs are changing the way of government doing business for the people and other stakeholders. In this context, e-government is seen to be a lever for the transformation of government in all sectors of its bodies [28]. E-government uses the application of ICT in public administration to streamline and integrate workflows. It helps for processes and manages data, information and human resource, financial resource, enhance public service delivery, as well as expand communication channels for engagement and empowerment of people [18].

According to Interim Constitution of Nepal [15], the civil service is an institutional mechanism to support the government in executing its tasks and realizing the goals of the nation state that have been defined under the Directive Principles and Policies of the State. Creation of a public welfare state is the main political objective, and a public service is to be set up and operated for fulfilling this objective. It specifies that the state shall be oriented towards promoting public welfare by maintaining peace and order in society, making arrangements for the just distribution of economic resources available in the country, and running the development activities for overall socio-economic development in collaboration with the governmental, cooperative and private sectors. The government's major role is to deliver the services to the people according to their demands and needs in a speedy, efficient and effective manner [27].

But the Present Constitution of Nepal [23] article 285 includes the provision of governance under three tiers, that is federal civil service, provincial government service and the local government service. The civil service is divided into professional (gazetted), support (non-gazetted) and helper (classless) personnel [4]. Professional staffs are grouped into 10 broad services: economic planning and statistics, engineering, agriculture, judicial, foreign, administrative, audit, forests, education and "miscellaneous." The minimum academic qualification for professional positions is a bachelor's degree. In 2010, there were 11,461 professional staffers, 42,529 at the support level and 21,838 at the level where jobs are not classified into classes (the support services). Since 2007, the government began holding separate competitions among women (33%), indigenous nationalities (27%), Madhesis (22%), the downtrodden (9%), persons with disabilities (5%) and candidates from backward regions (4%) to fill vacancies in the civil service. The percentages refer to the positions reserved for these groups [27].

II. OBJECTIVE

The main objective of this article is to explore the challenges of effective service delivery in civil service of Nepal while implementing e-governance.

III. LITERATURE REVIEW

The objectives of e-governance is to provide the services to citizens by implementing simple, secure and reliable registration process, by developing consistency in process, by implementing transparency in valuation of properties and automating all the back office functions. The major strengths of the e-government policies are to cover all administrative civic functions, to complete online functioning, providing anytime anywhere solution to citizens, to provide user, the internet technology with browser based interfaces, to provide an effective user technology for providing single window solution, to establish a proper workflow across departments, and computerization of municipal corporations [3]. Development of new technologies allows electronic services to be applied in e-government [25]. E-government is considered as implication of ICT in order to improve public services, strengthen and support for public policies and decision making in policy level.

E-Government has been no-doubt a mechanism for the management of civil service at the global level [5]. Government's role has been mostly the effective service delivery to the citizens in low cost [22]. Civil service discipline and management practices needs to be objective, fair, honest and reasonable [14]. Performance may be taken into account in setting pay, or bonus levels, but must be based on actual performance, objectively assessed, and properly documented. In parliamentary democratic system state authority is exercised by the political leaders but for the operation of governance there is a civil service as a permanent government which plays the role of backbone[19]. He further claims, to make public administration people oriented, efficient, impartial and neutral political leaders should be conscious about the values, norms and ethics of civil service and there should not be any unnecessary political presser and hurdles.

For the developing countries in Asia and the Pacific, e-governance is increasingly being emphasized as a way for governments to strengthen good governance. If implemented strategically e-governance can not only improve efficiency of government processes, but it can also be a tool to empower citizens by enabling them to participate in the decision making processes at policy level of government's bodies [8]. In general, developing countries have been lagging behind in e-government use as compared to developed countries even though they have been facing various challenges [30].

The rapid advancement in ICT has undoubtedly influenced positive changes in carrying out administrative functions in government institutions and making work process cheap, easy and fast [8]. In order to meet the global challenges in administrative

management, the use of ICT for service delivery cannot be abandoned due to its reliability, accuracy and permanence [7]. Government shares IT like World Wide Web (WWW), Internet and mobile computing and software applications to reach out to citizens to improve effective service delivery to citizens [2]. New developments in ICT and software applications are fundamentally changing the way we live, work and interact with each other [1]. He further stated that improved ICT governance will ensure alignment, reduce risk and support unification. But new technology is making service delivery not easy due to its new innovation and lack of technical skill and knowledge to utilize it.

The civil organizations in Nepal, though they have a very short history of structured operation, are also practicing the use of ICT. The e-governance was coined from the very beginning by introducing main frame computer named IBM 1401 in 1971 from USA. The data processing of the country's data started with the establishment of the National Computer Center (NCC) in 1974. The involvement of private sector in the area of software development started during 1980's. The concept of outsourcing has already been implemented during 1982 [31].

According to Damodar Regmi [9] civil service is the important mechanism of the implementation of the government policy and plan. So, capability of civil service should be developed through effective human resource management. He said that to make civil service capable to meet the challenge and opportunity of the changing context, making it productive, technically skilled, responsible and creative; having positive attitude, good manner, and contemporary adjustment. Digital divide is a challenge to the implementation of e-governance, which is caused by the disparity in access to electronic services, and this may outcome from factors inclusive of class, race, age culture and geographical location [21]. The digital divide generally occurs in developing countries where there is a lack of infrastructure, technology friendly human resource, trust in e-governance, financial resources and access to modern technology such as internet, computers, new software applications and new models of mobile phones [16]. Trade unions that cover all employees up to gazetted class three officers are seen as institutions for bargaining rather than as institutions to strengthen the civil service [27].

The government as a service provider and manager of e-Government system must be ensured trust so that service recipients will be motivated to use e-Government service confidently [10] He again said that public trust is foundation of relationship between service provider and service recipients. So, public trust is one of the critical factors of successes through the system adoption. Thus the need for building trust between the

government and other stake-holders of e-government is considered a fundamental principle in designing and developing effective e-government system.

The government is always facing difficulty on to achieving its goal to make welfare of the citizen by ensuring effective service. In this context, the efficiency and effectiveness of the civil service need to significantly improved. Nepalese Civil Service (NCS) is often charged for its inefficiency, dishonesty and lack of professionalism. Various studies and discussion have shown that the first and foremost cause of de-motivation in NCS is inadequate salary to meet the minimum basic requirement and maintain standard of living. Due to lack of appropriate incentives, overspread impunities, lack of experience development environment, in appropriate and unjustifiable evaluation system, and lean provision of career development. This has seriously caused the delayed public service delivery for the general people [13] Administrative Restructuring Commission [6] spelled out the problems and challenges in civil service into six categories viz. policy related, structural, organizational, managerial, working procedure related and attitudinal. These problems basically capture the problems being faced by the Nepalese civil service adequately. The challenges of civil service management may be listed as:

The weak capacity in terms of resources processes and institutions (including institution building) are recognized as a big challenge because substantive reforms in the absence of capacity are clearly going to be an difficult task. The challenges and responsibilities are increasing but the size of the civil service is declining. Vacancies are lying unfulfilled, hindering the capacity of service delivery further exacerbating the lack of capacity. Weak coordination and other structural problems lead to lack of clarity and poor service delivery including institution building. The tenure of top leadership is highly volatile and uncertain. Trade unions that cover all employees up to non-gazetted class three officers are seen as institutions for bargaining rather than as institutions to strengthen the civil service. The multiplicity of trade unions in the same work place is a problem rather than strength.

There is a delay in service delivery particularly in offices with high levels of engagement with the public despite efforts to continually improve the situation and define completion time lines. The productivity of human and capital resources is poor, and is not helped by indifferent motivational measures and systems. The process of administrative reforms will take time as is experienced with the five reform commission reports and their implementation (Buch, 1952; Acharya, 1956; Jha, 2025 BS; Thapa, 2032BS; Koirala, 2048BS and ARC, 2008). The norms governing the civil service are process oriented and not results oriented, and this is reported as a cause for the poor attainment of planned

targets. In the absence of clarity of rules or transparency, transfers and placements and in some cases promotion have been reported to be contentious issues. Changing the bureaucratic culture may be a major challenge to transfer it from the status quo and from process orientation to result orientation, with a willingness to shoulder responsibilities and accountability [26].

IV. METHODOLOGY

To conduct this research, researcher has collected the primary data from civil servants of government organizations who are working at various parts of country whose primary role is to deliver service for citizens and adopted quantitative research technique. The researcher have developed questionnaire that consist of information about demographic, physical facilities, role of civil servants, service delivery, ICT training etc. from different groups

namely non technical sector. The collected data have been entered into SPSS 22 and data analysis has been done. Books, academic journals government annual reports and websites were also used for literature review.

V. RESULTS AND FINDINGS

The research survey was framed under the category of assessing infrastructure development, human resource development and management, trust on e-government system, digital divide and information security and data protection.

While assessing the issue of e-governance that enhances the level of good governance, the participants rated under the criteria of fully disagreed, disagreed, neutral, satisfied and fully satisfied. The table 1 represents the status of the civil servants in non technical sector.

Table 1: E-governance Vs good governance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fully disagreed	2	1.4	1.6	1.6
	Disagreed	3	2.1	2.4	4.0
	Neutral	8	5.7	6.3	10.3
	Satisfied	40	28.6	31.7	42.1
	Fully satisfied	73	52.1	57.9	100.0
	Total	126	90.0	100.0	
Missing	System	14	10.0		
Total		140	100.0		

Table 1 illustrates that 57.9 percent with majority of the participants claimed that they were fully satisfied on the influence of e-governance system for good governance. In the same way, only 1.6 percent fully disagreed about positive effect of e-governance over good governance. The satisfied level of e-governance on good governance was rated by 31.7% participants. It can be concluded from the data that almost all the participants agreed positive impact of e-governance for

enhancing good governance in the context of Nepalese civil service.

The sample taken from the population of civil servants of Nepal government was rated under the theme of ICT usage they use for effective service delivery. The rate was counted in the category of 'No' and 'Yes'. Table 2 describes the assessment level of the participants.

Table 2: Use of ICT in service delivery

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	35	25.0	26.7	26.7
	Yes	96	68.6	73.3	100.0
	Total	131	93.6	100.0	
Missing	System	9	6.4		
Total		140	100.0		

Table 2 has illustrated that out of 140 participants, nine did not respond and out of 131 respondents 73.3 % rated that they agree on the use of ICT while providing the service to the people and only 26.7% rejected the use. It can be concluded that the majority of the civil servant think that the use ICT in non technical sector is very fruitful but there is very rare use of the ICT in work performance in the field.

The survey data was taken from the population of civil servants of Nepal government who are working at the various part of the country. It was rated under the scenario of digital divide in Nepalese civil servant. The rate was counted in the category of 'No' and 'Yes'. Table 3 describes the assessment level of the participants.

Table 3: Scenario of Digital Divide

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	63	45.0	51.2	51.2
	Yes	60	42.9	48.8	100.0
	Total	123	87.9	100.0	
Missing	System	17	12.1		
Total		140	100.0		

The table 3 shows that out of 140 participants, 17 did not respond and out of 123 who responded were in level of 51.2 percent to rate 'No' and 48.8 percent rated in 'Yes' category. It reflected that majority of the civil servants are not in technology friendly and others in favor.

The participants are assessed for the rating of the use of ICT at workplace with the category of fully disagree, disagree, neutral, satisfied and fully satisfied. Table 4 shows the level of rating by them.

Table 4: Use of ICT at Workplace

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fully disagreed	6	4.3	4.8	4.8
	Disagreed	30	21.4	24.2	29.0
	Neutral	35	25.0	28.2	57.3
	Satisfied	41	29.3	33.1	90.3
	Fully satisfied	12	8.6	9.7	100.0
Total		124	88.6	100.0	
Missing	System	16	11.4		
Total		140	100.0		

Table 4 has reflected that out of 140 participants, 16 were missing to respond and out of 124, 33.1 % rated for satisfactory level and 9.7 % rated for fully satisfied level. On the other hand 28.2% rated neutral and 24.2 percent disagreed on the use of ICT in workplace. Only 4.8% rated for fully disagree. It can be concluded that a major volume of civil servants agree for the use of ICT in workplace that may enhance their performance.

The information security and data protection was felt a major challenge in Nepalese e-governance implementation and it was assessed in five point scale including fully disagreed, agreed, neutral, satisfied and fully satisfied level. The major categories rated have been presented on the table 5.

Table 5: Information security and data protection challenge in e-service

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fully disagreed	6	4.3	4.7	4.7
	Disagreed	1	.7	.8	5.5
	Neutral	7	5.0	5.5	10.9
	Satisfied	45	32.1	35.2	46.1
	Fully satisfied	69	49.3	53.9	100.0
	Total	128	91.4	100.0	
Missing	System	12	8.6		
Total		140	100.0		

Table 5 has shown that out of 140 non technical civil servants, 12 did not respond, out of 128 participated on the survey and rated that 53.9% declared that they were fully satisfied and 35.2% satisfied that there is challenge in information security and data protection if e-governance is implemented at present. Only 4.7% fully disagreed and 0.8 % disagreed about the challenge of information security and data protection. 5.5% remained neutral in this case. The data has declared that majority of the people working in civil service realized that there is challenge in information security and data protection.

VI. DISCUSSION

The data analysis of the survey declared that sufficient ICT equipments and software applications though available in work place has not been fully utilized. On the other hand they also demonstrated that digital divide has played vital role in accepting the e-governance as there is gap in user and non user of digital devices within civil servants. The sophisticated infrastructure of ICT based applications and accessories were insufficient in work place at all the government bodies particularly in remote area. The information security and data protection has been realized as a major challenge in the e-governance implementation. People have no trust in e-governance as they were not fully ready to adopt it. Despite of the challenges in new technology in hardware and software, another challenge of restructuring of the state has added value for getting more assessment towards feasibility study in future. The human resource development and management in ICT sector has also been felt needed.

VII. CONCLUSION

The study has concluded that infrastructure development, human resource development and management, digital divide and information security and data protection have been the major challenges of effective service delivery in civil service of Nepal. Unnecessary influence of middleman in the public

service delivery, lack of open competition in the public procurement has been influenced by syndicate of some hidden groups. Needless expansion of government agencies and its employees; too many layers in the decision-making process; service delivery is more process oriented rather than result oriented, failure to make individual officials responsible; and a lack of decentralization of necessary authority to the officials down to the field offices are also found as huddles. The challenge of state restructuring and reform has also added value of the implementation of e-governance in future. The challenges have been tried to address through the design of e-government master plan, restructuring of civil service and reform. The government has to bring regular capacity development programme for civil servant and service providers towards ICT innovations and its application.

VIII. WAY FORWARD

The Public Service have been more agile and deliver more user centric and pioneering services for common people if we able to implement the following ICT strategy in Nepalese civil service.

- Innovative use of ICT in the Public Service may deliver better value for taxpayers by creating efficiencies through integration, consolidation and sharing of common infrastructure, systems and resources.
- Adoption and facilitation of digital technologies may increase productivity, improve the relationship between citizens, businesses and government and will deliver social and economic benefits for Ireland.
- Integrated services and increased data sharing may drive significant efficiencies; will facilitate insight driven decision making; will increase openness and transparency between Government and the public; and will provide a much higher user experience and quality of service for citizens, businesses and public servants.
- Improved ICT governance may ensure alignment, reduce risk and support unification as envisaged.

The future needs for ICT skills can be met through professionalization of ICT streams, targeted recruitment and improved mobility and succession planning across all Public Bodies.

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Abbreviations

E – Government : Electronic Governemtn
 E- Governance : Electronic Governance
 e-Sewa : Electronic Sewa
 IBM : International Business Machine
 ICT : Information Communication Technology
 IT : Information Technology
 NCC : National Computer Center
 NCS : Nepalese Civil Service
 UK : United Kingdom
 USA : United State of America
 WWW : World Wide Web

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Supplier Selection Model using Game Theoretical Approach

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Abstract- The purchasing function has gained importance in supplier selection of procurement. As the evaluation of the supplier depends on various non-price attributes, formulating the strategy is very important. Every supplier tries to play tactical game in order to win the contract under uncertain situations. In our paper we propose a model through case study to select best supplier using game theoretical approach by applying simplex algorithm.

Keywords: *game; payoff matrix; supplier invitation; supplier selection; game theory model.*

GJCST-G Classification: *F.4.1*



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Supplier Selection Model using Game Theoretical Approach

Nagabhushan S.V^α, Dr. K. N Subramanya^σ & Dr. Srinivasan G.N^ρ

Abstract- The purchasing function has gained importance in supplier selection of procurement. As the evaluation of the supplier depends on various non-price attributes, formulating the strategy is very important. Every supplier tries to play tactical game in order to win the contract under uncertain situations. In our paper we propose a model through case study to select best supplier using game theoretical approach by applying simplex algorithm.

Keywords: game; payoff matrix; supplier invitation; supplier selection; game theory model.

I. INTRODUCTION

The objective of study in game theory formal model of an interactive situation between the suppliers. It typically involves several players; a game with only one player is usually called a decision problem. The formal definition lays out the players, their preferences, their information, and the strategic actions available to them, and how these influence the outcome. Game theory is the formal study of conflict and cooperation. Game theoretic concepts apply whenever the actions of several suppliers are interdependent. These suppliers may be individuals, groups, firms, or any combination of these. The concepts of game theory provide a language to formulate, structure, analyze,

II. ANALYSIS

The objective is to select the best supplier from numerous suppliers with respect to understanding strategic scenarios. [1]Game theory and mechanism design offer an important tool to model, analyze, and solve decentralized design problems involving multiple autonomous agents that interact strategically in a rational and intelligent way. In the past decade, game theory and mechanism design have emerged as an important tool for solving numerous problems in computer science and Internet economics problems. Examples of these problems include design of decentralized algorithms involving selfish agents, design of sponsored search auctions on the web, design of procurement markets in electronic commerce, design of robust communication protocols, design of resource allocation mechanisms in computational grids, analysis of social networks, etc. An emerging discipline, algorithmic game theory, which is concerned with

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design and analysis of game theoretic algorithms, is now an active research area [3].

Basic elements of a Game:

- Players
 - Everyone who has an effect on your earnings
- Strategies
 - Actions available to each player
 - Define a plan of action for every contingency
- Payoffs
 - Numbers associated with each outcome.
 - Reflect the interests of the player.

In this method, the payoff values are considered for each of the supplier with respect to the parameters and the payoff matrix is obtained from those values. The maximum and minimum values are obtained for the payoff matrix and the value of the game is obtained. Based on the value of the game, the objective function and the constraints are identified and are solved using the simplex method. The values for each supplier are calculated using the simplex model[4] and the supplier with the optimal value is considered to be the best supplier [2].

III. METHODOLOGY

a) Algorithm

The steps for the computation of an optimum solution are as follows:

Step-1: Check whether the objective function of the given L.P.P is to be maximized or minimized. If it is to be minimized then we convert it into a problem of maximizing it by using the result Minimum $Z = -$ Maximum ($-z$)

Step-2: Check whether all right hand side values of the constrains are non-negative. If any one of values is negative then multiply the corresponding in equation of the constraints by -1, so as to get all values are non-negative.

Step-3: Convert all the in equations of the constraints into equations by introducing slack/surplus variables in the constraints.

Step-5: Compute the net evolutions $Z_j - C_j$ ($j=1,2,\dots,n$) by using the relation $Z_j - C_j = CB X_j = C_j$. Examine the sign.

- If all net evolutions are non-negative, then the initial basic feasible solution is an optimum solution.

- ii) If at least one net evolution is negative, proceed on to the next step.

Put the costs of these variables equal to zero.

Step-4: Obtain an initial basic feasible solution to the problem and put it in the first column of the simplex table.

Step-6: If there is more than one negative net evolution, then choose the most negative of them. The corresponding column is called entering column. If all values in this column are 0, then there is an unbounded solution to the given problem. If at least one value is > 0 , then the corresponding variable enters the basis.

Step-7: Compute the ratio $\{X_B / \text{Entering column}\}$ and choose the minimum of these ratios. The row which is corresponding to this minimum ratio is called leaving row. The common element which is in both entering column and leaving row is known as the leading element or key element or pivotal element of the table.

Step-8: Convert the key element to unity by dividing its row by the leading element it self and all other elements in its column to zeros by using elementary row transformations.

Step-9: Obtain the optimal value by the value in the X_B column with respect to the suppliers is basic variable column.

b) *Mathematical Terms*

Table I: Symbols and description

Symbols	Description
v	Value of the game
Y_j, y_i	Represents supplier

Assumptions in the Proposed Work

- Player(Supplier)
 - It is assumed that each player knows everything about the structure of the game
 - Player don't know about another's decision
 - Each player knows the rules of the game
 - Players are rational and expert
- Strategy
 - Each player has two or more well-specified choices
 - Each player chooses a strategy to maximize his own payoff
 - Every possible combination of strategies available to the players leads to a well-defined end-state (win, loss, draw) that terminates the game
- Payoff
 - Everything that a player cares about is summarized in the player's payoffs

- Mixed Strategy
 - A player is guessing as to which activity is to be selected in any particular occasion.
 - Probabilistic situation is obtained and the objective is to maximize the gain.
- Payoff Matrix
 - Contains the payoff values of the players with respect to the parameters.

IV. CASE STUDY

An Automobile company is intending to procure tires. There are 4 suppliers and 4 parameters as price, Quality, Delivery and Warranty. The supplier is selected based on the game theoretical method for mixed strategy game using simplex method with the following constraints.

Let us consider four suppliers and four criteria's namely-Suppliers = {S1, S2, S3, S4}, Criteria's = {Price, Quality, Delivery Time, Warranty}, Let us define pay-off values as-

$S1 = [3,3,4,0], S2 = [2,4,2,4], S3 = [4,2,4,0], S4 = [0,4,0,8]$

This can be represented as follows:

Table II: Payoff matrix for the suppliers with respect to parameters.

	S1	S2	S3	S4	Min
Price	3	2	4	0	0
Quality	3	4	2	4	2 minmax
Delivery	4	2	4	0	0
Warranty	0	4	0	8	0
max	4	4 maxmin	4	8	

- The above game has no saddle point, so solve the above matrix in LPP form
- The maximin is 2 and minimax is 4, therefore the value for the game is $2 \leq v \leq 4$ { i, e lies between 2 and 4} Hence $v > 0$
- To find the optimal value for suppliers considered as y_1, y_2, y_3, y_4 subject to constraints

$3y_1 + 2y_2 + 4y_3 \leq v$

$3y_1 + 4y_2 + 2y_3 + 4y_4 \leq v$

$4y_1 + 2y_2 + 4y_3 + 0y_4 \leq v$

$4y_2 + 8y_4 \leq v$

and $y_1 + y_2 + y_3 + y_4 = 1 \quad j = 1, 2, 3, 4$

since, v, v^* is greater than 0 dividing the above equation by „ v^* “ and putting $y_j/v = Y_j, j = 1, 2, 3, 4$

$Y_1 + Y_2 + Y_3 + Y_4 = 1$

Subject to constraints

$3Y_1 + 2Y_2 + 4Y_3 \leq 1$

$3Y_1 + 4Y_2 + 2Y_3 + 4Y_4 \leq 1$

$4Y_1 + 2Y_2 + 4Y_3 + 0Y_4 \leq 1$

$$4Y_2 + 8Y_4 \leq 1 \quad y_j/v = Y_j, j=1,2,3,4$$

In order to minimize v^* , maximize

$$1/v = Y_1 + Y_2 + Y_3 + Y_4 \text{ (objective function)}$$

The Standard LPP can be written as follows:-

Max

$$1/v = Y_1 + Y_2 + Y_3 + Y_4 + 0.S_1 + 0.S_2 + 0.S_3 + 0.S_4$$

Subject to constraints:

$$3Y_1 + 2Y_2 + 4Y_3 + S_1 = 1$$

$$3Y_1 + 4Y_2 + 2Y_3 + 4Y_4 + S_2 = 1$$

$$4Y_1 + 2Y_2 + 4Y_3 + S_3 = 1$$

$$4Y_2 + 8Y_4 + S_4 = 1$$

The simplex table is written for the above SLPP as follows:-

$$Y_1=0, Y_2=0, Y_3=1/4, Y_4=1/8, 1/v=3/8, v=8/3$$

$$Y_1 = y_1/v$$

$$y_1 = Y_1.v$$

$$y_1 = 0.8/3$$

$$y_1 = 0$$

$$\text{similarly } y_2=0, y_3=2/3 \text{ and } y_4=1/3$$

Since y_1 and $y_2=0$, Supplier 1 and 2 are out of the game. Supplier 3 (y_3) = 2/3 Supplier 4 (y_4) = 1/3.

Since supplier 4 is having the minimal value, "S4" is considered to be the best supplier.

Table 2: Calculation Table

Basic Variable	C_B	X_B	Y1	Y2	Y3	Y4	S1	S2	S3	S4	Max ratio X_B/X_k		
S1	0	1	3	2	4	0	1	0	0	0	-		
S2	0	1	3	4	2	4	0	1	0	0	1/4		
S3	0	1	4	2	4	0	0	0	1	0	-		
S4	0	1	0	4	0	8	0	0	0	1	1/8		
	$1/v=0$		-1	-1	-1	-1	0	0	0	0			
S1	0	1	3	2	4	0	1	0	0	0	1/4	1/4	1/4
S2	0	1/2	3	2	2	0	0	1	0	-1/2	1/4	0	1/2
S3	0	1	4	2	4	0	0	0	1	0	1/4	0	0
S4	0	1/8	0	1/2	0	1	0	0	0	1/8	-	-	-
	$1/v=1/8$		-1	-1/2	-1	0	0	0	0	1/8			
S1	0	0	-1	0	0	0	1	-4	2	2			
S2	0	1/4	1	1	0	0	0	1	-1/2	-1/2			
S3	0	1/4	1	1/2	1	0	0	0	1/4	0			
S4	0	1/8	0	1/2	0	1	0	0	0	1/8			
	$1/v=3/8$		0	0	0	0	0	0	1/4	1/8			

V. CONCLUSION

The game theoretical method allows selecting the best supplier in an effective way where the selection is done based on the strategies of the supplier used in the model. The model can be considered effective as it uses the mixed strategy game technique where the activities of another supplier are a guess and objective is always to maximize the gain.

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Instability of Stable Matching: A Dynamic Trust Approach

By Rejwana Haque & Sifat E Jahan

Abstract- Matching is one of the essential problems in computer science and finding the stable matching is often difficult. For example, matching the medical students to hospitals where each student has its own preferences as well as each hospital has its own category in order to select the interns it can be difficult. Therefore there are many constraints that one needs to look at before solving matching problems. There are some algorithms which ensure that it is possible to find a stable matching solution of this type of problems if any exists. In this paper, the instability of stable matching algorithm in dynamic environment has been demonstrated. The approach consists in mapping a specific stable matching problem (stable marriage problem) which has a stable solution into a dynamic environment where the instability is shown by using dynamic trust model.

Keywords: *stable matching, dynamic trust model, stable marriage problem, trust management, algorithm instability.*

GJCST-G Classification: *H.3.m*



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Instability of Stable Matching: A Dynamic Trust Approach

Rejwana Haque^α & Sifat E Jahan^ο

Abstract- Matching is one of the essential problems in computer science and finding the stable matching is often difficult. For example, matching the medical students to hospitals where each student has its own preferences as well as each hospital has its own category in order to select the interns it can be difficult. Therefore there are many constraints that one needs to look at before solving matching problems. There are some algorithms which ensure that it is possible to find a stable matching solution of this type of problems if any exists. In this paper, the instability of stable matching algorithm in dynamic environment has been demonstrated. The approach consists in mapping a specific stable matching problem (stable marriage problem) which has a stable solution into a dynamic environment where the instability is shown by using dynamic trust model.

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I. INTRODUCTION

Given two different sets, the elements of one set mapped to the elements of another set is known as matching. A matching is called stable if there is no pair (A, B) such that both are better matched than their current matched element. If there is an element A of one set which desires another element B of the second set over its current matched and the element B as well desires A over its current matched element, this matching is known as not stable matching.

A stable matching problem consists of finding a stable matching given two evenly sized sets of elements as well as an ordering of the elements' preferences. The solution obtained from this type of algorithms guarantee that the assigned pairs of elements won't prefer any other partners to their current partners.

There are also some stable matching algorithms which allow ties in their preference lists. The absence of an unmatched pairs of elements where those elements prefers each other to its current matched element is required for the stability of the solution of this type of algorithms.

There are many variants of stable matching problems:

- *Stable marriage problem [7]:* This problem consists on finding a stable matching of n couples. There will a list of n men with their preferred list of n women, a list of n women with their preferred list of n men. The

preference list will contain the ranking of the individuals according to their choices from high to low. A man will propose a woman, according to his preference list and if the woman is available, then it will be paired with that man and the output will be a certain list containing the matched couple.

- *Stable roommates problem [3] [8]:* This problem is very similar to stable marriage problem, however it requires to have a single set with n cardinality, with each member having preferences respect the rest of the members. The stable matching is considered as the initial set partitioned into $n/2$ pairs such that there is no two unmatched members that both of them prefer each other instead of their current partners. There is a possibility of a stable matching does not exist.
- *Assignment problem [9]:* The problem consists in finding the best possible assignment to a set of jobs to complete for a set of persons, where the jobs are ranked by total scores or by the ratings of the employees assigned to those jobs.
- *College admission problem [5]:* This problem is also known as hospital/residents problem and it also very similar to stable marriage problem. The main difference between these two problems are that in the hospital/resident problem one hospital can take more than one residents where as in stable marriage problem a man take have only one woman. That is, here one-to-many relationship is permitted.
- *Hospitals/residents problem with couples [6]:* This problem is a variation of the previous problem adding some other constraints. Here, the residents which are couples must be mapped to the same hospital. The members of a couple will have their own list of preferences in order to rank the hospitals and the joint preference list will be consider for matching.

Researchers have been using trust theories to construct different type of trust models to overcome unacceptable behaviors. Trust issues have become more suitable nowadays to prove the efficiency of certain algorithmic issues. These trust models have been used to model various aspects such as network security approaches, user authorization [17] or firewall access control measurements. The trust and reputation of the models are vital to ensure a correct behavior

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among the agents involved. Consider the example of real estate consultancy site, the required elements are finding a suitable plot are, best interior facilities, etc., where the integrity trust is vital and is based on elements such as the existence of fraudulent charges on customers. In this particular context, an agency with lowest integrity trust will be preferred where having better deals are more considered than the risks of being fraud. There are many types of trust models:

- *McKnight's Trust Model [13]*: The social trust model is described in this computation model. This model defines five types of trust: trusting belief (faith in truster to provide benefices on trustee), trusting behavior (trusts action to expose a risk or increase trust), institution based trust, trusting intention (trust decision influencing trust behavior), and disposition to trust (influence institution-based trust, trust intention and trusting belief). The institution-based trust is subdivided to:
 - *Structural pledge*: The trust of a successful outcome having an organized structures. This is more relied on trusting intention and not to trusting belief.
 - *Situational normality*: The trust of a successful outcome having a properly ordered environments. Both trusting intention and belief influence situation normality.
- *Computational Trust Models [11]*: The context and situation trust is described in this type of models which are involving dynamic environment. Applications such as trust on social networking sites or access control in P2P networks [10] are based on this type of modeling.

Matching is present in all aspects of human life such as the selection of education institutions, the selection of a country for higher education or the selection of a new residency and finding a stable matching of these problems are crucial. Researchers have been successfully demonstrated that is possible to find a solution of these type of problems having an ordered list of preferences. Even though these algorithms are well structured and strongly illustrated, in practice these are not widely studied. The human mind is still an immense mystery and in any time human perception can be changed, that is, their preferences can be changed suddenly which is the main motivation of this research paper. These type of algorithms are based on the preferences of people or institutions (e.g. there is a human mind behind it) and such preferences can be changed in any time so how the stability of the algorithms can be defined on such situations. The same situation can be modeled in the network flow of a packet where the paths that the packet can flow may varies given the environment constraints. In this paper the stable marriage problem has been chosen to be modeled in a dynamic environment using computational

trust models (specifically, dynamic trust model) and find the instability of this algorithm.

The paper is organized as follows. Section I contains the introduction of paper emphasizing on this motivation of the research work and section II describes and reviews the related works. In section III the research proposal is explained in detail, section IV contains the experimental results explained with example in detail. The section V and VI contains possible future directions and limitations of this research study respectively. The paper concluded with conclusion in section VII.

II. LITERATURE REVIEW

In order to proceed with the proposed research study understanding the entire concept of stable marriage problem and how the dynamic trust model works is essential. The following papers are the main basis of this study:

- *Gale-Shapley Algorithm [5] [16]*: The stable marriage problem is first studied by Gale and Shapley in the paper [5]. They studied marriage problem and defined an algorithm to solve it with a stable matching solution, as well as they prove that the stable matching is possible. The main purpose is to match the men with women (one-to-one relationship) in such a way so that no unmatched couple prefers each other instead of their current partner. By solving this problem, this authors extended their solution to college admission problem.
- *Secured Trust [2]*: In this paper a dynamic trust computational model has been proposed for providing security in communication of multi-agent systems. In this research study the authors uses different trust calculations on the agents to find the existence of any malicious behavior among those and proposed a comprehensive model for such trust calculations and a load balancing algorithm to possible the cope up with malicious agents behaviors at the same time providing an efficient workload distribution to the agents.

Very few works have been done combining stable matching with trust models. However, there are some works which are concerned with the stability of stable matching. The most important are:

- In this paper [1], the researchers demonstrate that the stability of stable matchings in the social context make a huge difference. They study the stable matching problems where players are entrenched in the social context, and relation such as friendship or altruism may impact in their decisions. Basically, the care towards friends among players plays a vital difference in the quality of stable matching solutions.
- In paper [4], they propose a stable matching algorithm which can provide an almost stable

matching by knowing only its neighborhood. They show their results by applying the proposed algorithm in bicolored graphs to find maximum-weight matching and for the size of stable matching a centralized randomized constant-time approximation scheme is used.

- The preferences of the participants are exposed in the existing stable matching algorithms which violates their privacy as well as it creates a possibility of manipulation of the algorithm. Having in mind all this concern a private stable matching algorithm is proposed in [6] which guarantees to provide a stable solution.
- The complexity of stable matching problems has been studied in [14]. In this paper, the roommate problem and residents problem with couples have been studied and demonstrated the NP-completeness of these problems if ties are allowed or not. They show that the roommate problem is NP-complete if ties are allowed and residents problem with couples is NP-complete with or without ties.
- The two-side matching problems are addressed in [15], mainly the market failures associated with the instability of the stable matching has been studied. Allowing random selection of pairs will converge to stable matching with probability one is shown in this research.

III. METHODOLOGY

The proposed approach is proving the instability of stable matching solution of the stable marriage problem using dynamic trust model. The dynamic model is based on specific trust calculations, such as historic trust or expected trust; the paper [2] has been studied for the following measurements and to implement stable marriage solution the paper [5] has been focused. Basically, the trust models have been used to model the human behavior computationally.

The following steps have been followed to prove the instability of the stable matching:

- Evaluate current satisfaction for current transaction.
Satisfaction means the degree of comfort the couple has together. Current satisfaction represents the satisfaction for the most recent transaction.

$$Sat_{cur} = \begin{cases} 0 & \text{if the transaction is fully unsatisfactory} \\ 1 & \text{if the transaction is fully satisfactory} \\ \varepsilon(0, 1) & \text{otherwise} \end{cases} \quad (1)$$

As in real life the behavior of a person cannot be pre assumed and human behavior can changed time to time, so for our implementation we took random value form 0 to 1 of evaluating current satisfaction.

- Calculate Direct trust up to current transaction satisfaction.

Direct trust keeps record of the satisfaction level of all the transaction the couple have together. Initial

value direct trust $DT_0^0(p, q) = 0$. If the amount of satisfaction the couple p and q have together at n^{th} transaction in t^{th} time interval, then direct trust is calculated as follows:

$$DT_n^t(p, q) = \alpha \times Sat_{cur} + (1 - \alpha)DT_{(n-1)}^t(p, q)$$

the weight changes α changes based on the accumulated deviation $\xi_{n-1}^t(p, q)$.

$$\alpha = threshold + c \times \frac{\delta_n^t(p, q)}{1 + \xi_n^t(p, q)}$$

$$\xi_n^t(p, q) = c \times \delta_n^t(p, q) + (1 - c) \times \xi_{n-1}^t(p, q)$$

Here c is constant factor which controls to what extent participants will react to recent errors $\delta_n^t(p, q)$. The recent value of satisfaction is given more significance than past trusts. So, if we increase the value of c then we give more significance to the recent deviation than the accumulated deviation and vice versa. Again, we can see that as recent error ($\delta_n^t(p, q)$) increases so does α which means that recent satisfaction is given higher weight than accumulated satisfaction.

- Calculate Recent trust. Recent trust reflects only the recent behavior. The recent trust between participants is calculated as follows:

$$RT_n^t(p, q) = DT_n^t(p, q)$$

- Calculate Historical trust up to current time interval.
Historical trust means past experience of the participants to one another. As in real life human forget past so for calculating historical trust forgetting factor is introduced.

$$HT_n^t(p, q) = \frac{\rho \times HT_{n-1}^t(p, q) + RT_{n-1}^t(p, q)}{2}$$

- Calculate Expected trust based on Recent trust and Historical Trust.

Expected trust reflects expected behavior of the couple to one another. In real life it is deduced from both recent and historical trust. In other words, we are combining both recent behavior and historical behavior to get a prediction of the future behavior.

$$E_n^t(p, q) = \eta RT_n^t(p, q) + (1 - \eta)HT_n^t(p, q)$$

Initially $E_n^t(p, q) = 0$ as expectation remains zero before any transaction. We calculate the expected trust of each pair of participants for each time interval and generated trust matrix at time interval t.

- Update preference matrix based on Expected trust.
Based on the Expected trust of the participants the preference matrix for stable matching is generated.

The satisfaction of participant's transaction has not been selected randomly, instead a defined range has been used.

IV. EXPERIMENTAL RESULTS

The experimental results show the result of matching N men with N women where N=5 with time interval 3. The step-wise expected trust and preference calculation has been shown in the below tables.

Table I: Expected Trust

Time interval: 2				
0.9088	0.5559	0.5107	0.5379	0.9076
0.4082	0.9171	0.4612	0.4713	0.9232
0.4700	0.5257	0.9057	0.6220	0.8990
0.4310	0.6355	0.4956	0.8979	0.8965
0.9257	0.8871	0.8965	0.9236	0.8963

Time interval: 3				
0.9553	0.4056	0.5466	0.5289	0.9458
0.5846	0.9462	0.5328	0.3969	0.9425
0.5337	0.5342	0.9534	0.4396	0.9300
0.5491	0.4302	0.5882	0.9168	0.9362
0.9465	0.9270	0.9363	0.9309	0.9239

Table I shows the expected trust of the participants of 3 time intervals. $Val(i, j, t)$ means Expected Trust of Participant i to Participant j at time interval t after n transaction and vice versa.

Based on the expected trust preference of male and female is calculated for different time interval.

Table II: Preference of Female

Time interval: 1				
5	1	2	4	3
5	2	4	3	1
3	5	1	4	2
5	4	3	1	2
3	2	5	4	1

Time interval: 2				
5	1	3	4	2
2	5	4	1	3
3	5	1	4	2
5	4	3	1	2
2	1	3	4	5

Time interval: 3				
1	5	2	4	3
2	5	3	4	1
3	5	4	1	2
5	4	1	3	2
1	2	4	3	5

Table II shows the preference of Female at different time intervals $Val(i, j, t)$ preference of i^{th} Female at time interval t.

Table III: Preference of Male

Time interval: 1				
5	1	4	3	2
5	2	4	1	3
3	5	4	2	1
5	4	2	3	1
1	4	2	5	3

Time interval: 2				
1	5	2	4	3
5	2	4	3	1
3	5	4	2	1
4	5	2	3	1
1	4	3	5	2

Time interval: 3				
1	5	3	4	2
2	5	1	3	4
3	5	2	1	4
5	4	3	1	2
1	3	4	2	5

Table III shows the preference of Male at different time intervals $Val(i, j, t)$ preference of i^{th} Male at time interval t.

After 1st interval stable matching is done based on the preference list of male and female after 1st time interval.

Table IV: Preference of Female after 1st time interval

1 st	2 nd	3 rd	4 th	5 th
5	1	3	4	2
2	5	4	1	3
3	5	1	4	2
5	4	3	1	2
2	1	3	4	5

Table V: Preference of Male after 1st time interval
Female Male

1 st	2 nd	3 rd	4 th	5 th
1	5	2	4	3
5	2	4	3	1
3	5	4	2	1
4	5	2	3	1
1	4	3	5	2

Table VI: Stable matching after 1st time interval

Female	Male
5	1
1	2
3	3
4	4
2	5

Table VII: Female Preference list after the 2nd time interval

1 st	2 nd	3 rd	4 th	5 th
1	5	2	4	3
2	5	3	4	1
3	5	4	1	2
5	4	1	3	2
1	2	4	3	5

Table VIII: Male Preference list after the 2nd time interval

1 st	2 nd	3 rd	4 th	5 th
1	5	3	4	2
2	5	1	3	4
3	5	2	1	4
5	4	3	1	2
1	3	4	2	5

We calculated the stable matching of $N = 5$ participants at $T = 3$ different time interval. The results are different for different time interval. Which means Stable matching at time $T = t$ will be unstable at time $T = t + 1$.

Table IX: Stable matching

Time interval: 1	
1	1
2	3
3	2
4	4
5	5

Time interval: 2	
1	5
2	1
3	3
4	4
5	2

Time interval: 3	
1	1
2	2
3	3
4	5
5	4

Table IX shows Stable matching in different time interval.

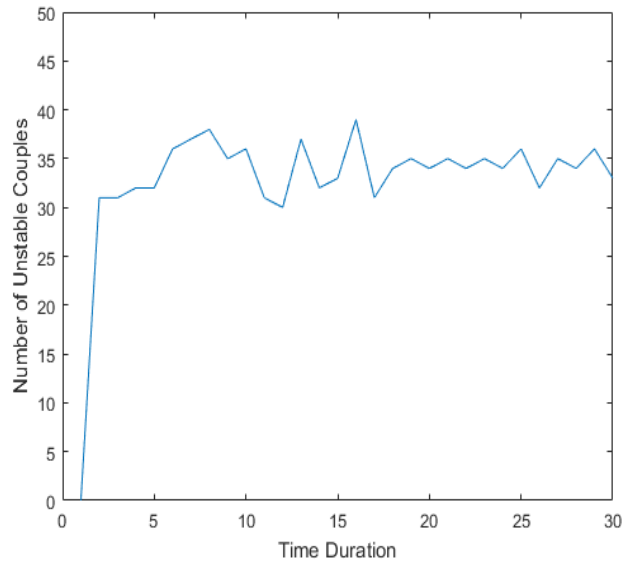


Fig.1: Unstable couples created in different time intervals

Figure 1 shows the number of unstable couples created with different time intervals, where the number of participants is 50 and time interval of 30 have been considered. Using dynamic trust modeling we have proved the instability of stable matching algorithm which is clearly shown in above graph.

V. LIMITATIONS

The proposed approach has some limitations as it takes in consideration some specific constraints. The approach only takes N men and N women, whereas the number of men and women may vary time to time. The time decay model has not been considered for the implementation which imposes one of the boundaries of this approach and lastly only direct experience has been considered.

VI. FUTURE SCOPE

In future, this research can be further expanded to different stable matching problems such as assignment problem or college admission problem. In the proposed approach only one-to-one mapping has been considered, thus many-to-one or many-to-many problems can also be addressed in future. Also, the limitation can be overcome by considering different trust models and including time decay model.

VII. CONCLUSION

There are many algorithms that states that matching problems can find a stable solution. However, the stability of these solution have not studied so far. In this paper, we proposed a novel approach to identify the instability of stable matching solutions given by those algorithms. Mainly, stable marriage problem has been

considered to be mapped in a dynamic environment where human behavior is modeled by using trust models.

Even though the instability of stable matching has been proved, there are some limitations in this approach which the researchers have planned to overcome in future by integrating different trust calculations as well as by integrating time decay model.

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Cyber Forensic and Data Collection Challenges in Nigeria

By Whyte Stella Tonye

Abstract- The importance of structural investigation to obtain a reliable chain of evidence on cyber-attacks organizations or individual data for application of legal presentation in court in computer forensics. Where ever there is a discovery of evidence or proofs of illegal misuse of organization data it leads to the prosecution of the culprits. Today the technology in cyber forensic is utilizing the application of scientific methods and technics to recover data from electronic and digital media. This scientific method requires expertise that goes beyond regular forensic data collection, techniques, and practices which must conform to universal standards. Increase in the use of computer and the internet has resulted in the change in human behaviors and ways in which they communicate, this growth in technology has given rise to cybercrimes which have caused the insecurity of the cyberspace in general. The increase in the growth of computer and the Internet use has changed the human behavior and ways of communication, this growth in technology has given rise to the rise in cybercrime which is now sophisticated and difficult to trace, investigate, and prosecution of criminals without reliable and accurate data collection.

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Cyber Forensic and Data Collection Challenges in Nigeria

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Abstract- The importance of structural investigation to obtain a reliable chain of evidence on cyber-attacks organizations or individual data for application of legal presentation in court in computer forensics. Where ever there is a discovery of evidence or proofs of illegal misuse of organization data it leads to the prosecution of the culprits. Today the technology in cyber forensic is utilizing the application of scientific methods and technics to recover data from electronic and digital media. This scientific method requires expertise that goes beyond regular forensic data collection, techniques, and practices which must conform to universal standards. Increase in the use of computer and the internet has resulted in the change in human behaviors and ways in which they communicate, this growth in technology has given rise to cybercrimes which have caused the insecurity of the cyberspace in general. The increase in the growth of computer and the Internet use has changed the human behavior and ways of communication, this growth in technology has given rise to the rise in cybercrime which is now sophisticated and difficult to trace, investigate, and prosecution of criminals without reliable and accurate data collection.

I. INTRODUCTION

The emergence of the world wide web and the development of the information technology have necessitated the rise in a cyber investigation, as cybercrime is growing so fast and maturing into a more challenging issue and need to be confronted (Kumari and Mohapatra, 2016). A gap is seen with regards to analysis of large and disparate datasets and data collection strategies as the existing forensic software solutions developed from the first generation of tools addressed mainly scalability issues. As the volume of data increases it affects the capability of processor speed and the rate forensic tools can manage (Darren and Kim-Kwang, 2014).

Harichandran, Breitingger, and Baggili (2016) stated that the increase in the number of successful cyber-attacks is threatening financial and personal security worldwide. Currently, there is a shift from the usual hobby hacking to a well-organized cybercrime. These attacks are now typically carried out for personal and commercial purposes in a more sophisticated and targeted manner in the bid to circumvent common security measures. (Skopik, Settanni, and Fiedler, 2016). Several cyber forensic techniques are used to Investigate these increasing cybercrimes. These

techniques assist in tracking down internal and external network attacks by focusing on inherent network vulnerabilities and communication mechanisms (Suleman et al. 2015).

Cyber Forensic is a field that is new and emerging with the introduction of new technologies readily accessible, available, affordable, and heavily dependent on individuals and businesses. As technology grows, new criminal techniques and activities known as cybercrimes emerge, posing challenges to law enforcers (Hamid & Amin, 2014). According to Zhou and Ziang (2012), cyber forensic is a brand new technology in the law of information security, with two procedures; first, searching for evidence and secondly taking out the evidence. It is therefore essential to protect data from targeted system attack. Very important is to prevent hackers from attacking and stealing away organization data and electronic evidence. Organizations could prevent these attacks by collecting related data and analyzing security policies/procedures and knowing the security status of the entire system and securing personnel awareness level.

A reliable data collection is the beginning of successful operations of an analysis system as the accuracy of data is directly affected by strategies of data collection (Zhou and Ziang, 2012). According to Sesan, Soremi, and Oluwafemi (2015), the recent incidents of ATM fraud, identity theft, email hijacking of email accounts, and phishing on individuals and the financial institutions has increased the rate of cybercrime in Nigerian. This has resulted to a hype in the economic cost of cybercrime to Nigeria which was before now unknown. Sesan et.al's work shows that higher incidence of cybercrime is seen more in the Western and Eastern parts of the country although a small sample size was used. The general IT problem is that most developing countries like Nigeria do not have strategies to ensure reliable forensic data collection to carry out forensic investigations. The specific IT problem is that IT managers lack strategies to ensure the reliability of cyber forensic data collection for forensic investigations. Again most studies on cyber forensic are done outside of the shores of the country. Hence this paper examines the challenges of cyber forensic data collection in Nigeria.

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II. LITERATURE

This study used the disruptive innovation theory as a framework. Clayton Christensen coined the theory and analyzed the phenomenon in 1995. Disruptive innovation theory describes a process where product or service takes its root from simple applications at the bottom of the market and rigorously moves up the market, eventually displacing established competitors. (Christensen, 2016). The author developed the disruptive innovation theory for evaluation and clarification of business strategies to respond to technological change. Disruption theory helps the development of new technology to make a strategic choice between taking a sustainable path and taking a disruptive one. Identification of the technology industries has resisted the forces of disruption, at least until very recently. Cyber forensic globally is one of such. Over more than 100 years, new kinds of technology with diverse initial charters created helped to address the problems of various population segments. The use of this disruptive theory in this study makes collection of reliable forensic data measurable and significantly more accurate as predictions of which cyber forensic investigations will succeed (Christensen et al., 2015). The theory is also used to explore cyber forensic investigations as the type of destructive innovations which requires a fundamental shift in ways data collection for investigation is carried out by investigators.

III. CONCEPT OF CYBER FORENSIC

According to Losavio, Pavel, & Polyakova (2015), cyber forensic is the search to reliable evidence within electronic information. Computer forensics is the practice of collection, analyzing and reporting on digital data in a legally admissible manner. It is used in the detection and prevention of crime and in any dispute when evidence is stored digitally (Forensic control, 2016). The practice follows a similar process to other forensic disciplines and faces related issues. Aziz (2014) defined a digital forensic tool called data acquisition as a more reliable tool to measure correctness, accuracy, and completeness for the course of justice and discovery of facts. The objective of this study is to explore strategies used by IT managers and investigators to ensure the reliability of cyber forensic data collection for forensic investigations of cyber-crimes. According to the Cyber Shield (2016, 9 August), more than 58% organization in the world still lack appropriate controls to prevent insider attack, with just 44% unaware that their organization ever had experience of an insider attack at all. The literature review aligns with the purpose of the study to explore best strategies employed by cyber forensic investigators, which successful cyber forensic investigation managers may use to ensure the reliability of data collection. An extensive review of books and

journal articles provided insight concerning the issue of data collection for cyber forensic investigations in Nigeria. According to Nte Ngoboawaji (2012), lack of forensic skills and equipment has negatively affected forensic investigation capabilities in Nigeria which have resulted in the high increase in unresolved murder cases. Oladele (2006) opined that the Nigeria police force which is charged with the responsibility of maintaining law and order, unfortunately, is inadequate thereby adding to the mystery of absence of justice as experts have linked criminal justice system to lack of absence of forensic evidence rendering justice ineffective.

This paper intends to identify the gaps observed in the previous research literature. In doing so, series of different topics associated with the issue of cyber forensic and data collection emerged including anti-forensic attacks, forensic investigations, digital forensic, computer forensic, and computer security. Books and journal articles were extensively reviewed to provide insight on the issue of data collection in cyber forensic investigations and challenges. The process yielded several different topics related to the subject of the study. The increase in the size of data to be presented for analysis has resulted in a significant challenge in computer forensic analysis. Materials published in the past five years (2011–2016), have been located by searching various academic databases including EBSCO, ACM digital lib, Google Scholar, and IEEEExplore to mention a few. The author checked keywords like computer forensics, data collection, computer forensic challenges, and forensic data on computer forensic on the internet. According to Daren & Kim (2014), there is a serious gap about cyber forensic data volume challenge about the acquisition of data and models used in the database. Issues in integration process of forensic cases have been raised on data acquisition and the modules used (Quentin et al. 2014). Gou, Jim, and Quim (2013), opined that email is one of the written form naturally used as documentary evidence and as a potential carrier of criminal evidence. The email header provides detailed technical information, such as the sender, software used by the composer and the email server. Technical digital forensic identifies, collects, preserves and analyses data in a way that preserves the integrity of the evidence gathered so that it can be used effectively in a legal case. Nickson and Venter, (2013) present a step by step framework in an attempt to propose a high-level procedure for enhancing the potential digital evidence presentation in any legal proceedings. Kumari and Mohapatra, (2016) iterated that cyber investigations and crime is growing and maturing into a more challenging issue which needs to be confronted early. They also declared that lack of digital forensic tools and techniques had hindered forensic investigations. Nickson and Venter (2015) in their paper also stated that cyber forensic methods assist in

tracking down internal and external network attacks by focusing on the inherent network vulnerabilities and communication mechanics. Losavio et al., (2015) in their study states that cyber forensic is the search for reliable evidence within electronic information which may result in infringing on users privacy. Slim and Nouredine (2013), describes techniques used in digital forensic investigations to be theoretical and scientific. The theoretical techniques are characterized by anti-forensic while the scientific techniques as the preparation of systems for forensic analysis. The theory of hierarchical visibility was proposed to investigate security incidents conducted over complex systems and to be used in the anti-forensic attack to investigate and provide or prove occurrences from uncomplicated evidence. Kumarri and Mohapatra, (2016) have also stated that lack of digital forensic tools and techniques has hindered forensic investigations.

IV. MATERIAL METHOD

This paper used the qualitative exploratory case study research method for this study. The author used the qualitative method for this study to establish exploratory actions to understanding the meaning behind actions and behaviors in employing strategies by IT managers in a cyber forensic investigation to ensure reliability in data collection. The research method is also used for conducting interviews is to obtain unique and comprehensive information from the participants undergoing the interview (Tuominen, Tuominen & Jussila, 2013). The justification for selecting qualitative rather than quantitative or mixed methods was by the preference to collect multiple sources of data. From the description of Malina, Hanne, and Selto (2011), mixed method researchers employ emphases on both qualitative and quantitative approaches to create a research outcome stronger than either method individually. The preferred method of the study was the qualitative method not quantitative or mixed method because researchers use the qualitative method as a means to involve directly with the participants (Toloie-Eshlaghy et al., 2011). The author used a qualitative method to seek an in-depth understanding of IT managers based on an insider's experience and perception of the phenomenon.

V. RESEARCH DESIGN

This paper uses the case study research design for the study. A case study design is an increasingly popular approach among qualitative researchers (Hyett, Kenny, & Dickson, 2014). Using a case study design has a level of flexibility that researchers may not have with other research methods such as phenomenology, narrative, and ethnography design (Hyett et al., 2014). The qualitative research method was used to establish exploratory actions by researchers to understand the

meaning behind actions and behaviors and to see the phenomenon from the perspective of the participants (Sinkovics & Alfoldi, 2012). The method allows the use of an in-depth exploration of the phenomenon by actively engaging with participants who have experiences with the phenomenon and expresses their perceptions in their understanding (Coenen, Stamm, Stucki, & Cieza, 2012). This paper uses the qualitative method to explore actions to understand the meaning behind actions and behaviors and to see the phenomenon from the perspective of the IT managers which both quantitative and mixed method which cannot of providing (Sinkovics & Alfoldi, 2012). Quantitative research method, on the contrary, is used by researchers to represent the generalization of a population with the use of numerical data to prove or disapprove a hypothesis (Hoare & Hoe, 2013). This paper would also give the author opportunity to interact with participants in day-to-day practice to explore issues in the context of work which is the intent of this study (Moll, 2012).

VI. SOCIAL IMPLICATION

Cyber forensic is the search to reliable evidence within the electronic information; this may result to infringing on personal privacy and challenging fundamental legal principles to protect forensic data. The investigations undergo legal and policy development to interconnectivity. Cybersecurity protects systems and networks against unauthorized access, data manipulation, and defense against any hacker or intruder (Olayemi 2014). Hence IT managers and business outfit and government agencies should ensure overall system integrity and sustainability of their network infrastructure. Also, organizations should increase its defense –in- depth approach to network and computer security with the adoption of appropriate cybersecurity wares.

More so, given that collecting evidence the digital media is properly examined and checked to identify, preserve recover and analyze facts and opinions about the information gathered. The evidence is usually difficult to collect as the right tools are not available to collect them or they are of low quality or as revealing the identity of the criminal is difficult.

VII. CONCLUSION

The number of successful cyber-attacks has risen significantly in the global world and continues to threaten financial and personal security. Cyber forensics has undergone a shift where evidence is massive in size and may be insufficient to convict cybercriminals and financial loss is recently a big worry in the globe with major concerns in standardization. These cyber forensic challenges can be reduced by researching new methods to improve reliable forensic data collection and

speed up evidence recovery and analysis for investigations. The government and organizations need to get better forensic tools and techniques to support a wider variety for investigative purposes. The objective of this study was to enlighten IT managers in government and private organizations in Nigeria with strategies to ensure the reliability of cyber forensic collection of data for forensic investigations to reduce cybercrimes and vulnerability in the society. The adoption of the information from this study may contribute to building a sustainable and less vulnerable society in Nigeria and other sub-Saharan African countries. Digital forensic investigation process models have provided guidelines to identify and preserve potential digital evidence captured from a crime scene, but the process for this forensic evidence to be admissible in court is a significant challenge to investigations as there are currently no standardized guidelines to present the standard collection and representations of digital forensic evidence. This paper, therefore, recommends that methodologies and expertise are needed in a country to enhance the potential cyber forensic digital collection, presentation, and interpretations in any legal proceedings.

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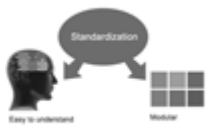
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- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in-depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of “Difference of Opinion [if any]” among the Board members, our decision will be final and binding to everyone.

”



PREFERRED AUTHOR GUIDELINES

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from <https://globaljournals.org/Template.zip>

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

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Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

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2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s) names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

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- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures



- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

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3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

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Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

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PREPARING YOUR MANUSCRIPT

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.



Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

- a) A title which should be relevant to the theme of the paper.
- b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
- c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
- d) An introduction, giving fundamental background objectives.
- e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
- f) Results which should be presented concisely by well-designed tables and figures.
- g) Suitable statistical data should also be given.
- h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

- i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
- j) There should be brief acknowledgments.
- k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

FORMAT STRUCTURE

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.



Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

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Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

TIPS FOR WRITING A GOOD QUALITY COMPUTER SCIENCE RESEARCH PAPER

Techniques for writing a good quality computer science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.



20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
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Approach:

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