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Highlights

- Adaptive Software Systems
- Excessive Oil-Gasoline Mixture
- Recycle and Reuse of Textile
- Function Allocation and Bandwidth

Discovering Thoughts, Inventing Future

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Function Allocation and Bandwidth Reservation for Mixed-critical Adaptive Software Systems

By Mahmoud Hussein
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Abstract- The new Auto SAR adaptive platform makes mixedcritical automotive systems able to adapt themselves in response to hardware and software failures at runtime. However, mapping functions of these automotive systems and reserving bandwidth for them are still major challenges. In this paper, we propose a model-based approach for mapping functions of an automotive system to its hardware nodes and reserving their bandwidth. To do so, an architecture description language for automotive systems (i.e. EAST-ADL) is used to design an embedded system, and to specify its timing requirements. The design model is then used for identifying functions allocation and their bandwidth in different system configurations.

Keywords: mixed-criticality; design space exploration, adaptive system; schedulability analysis; model-based.

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Function Allocation and Bandwidth Reservation for Mixed-critical Adaptive Software Systems

Mahmoud Hussein

Abstract- The new Auto SAR adaptive platform makes mixed-critical automotive systems able to adapt themselves in response to hardware and software failures at runtime. However, mapping functions of these automotive systems and reserving bandwidth for them are still major challenges. In this paper, we propose a model-based approach for mapping functions of an automotive system to its hardware nodes and reserving their bandwidth. To do so, an architecture description language for automotive systems (i.e. EAST-ADL) is used to design an embedded system, and to specify its timing requirements. The design model is then used for identifying functions allocation and their bandwidth in different system configurations. To schedule the critical functions of the system, the Earliest Deadline First (EDF) is used, while the Constant Bandwidth Server (CBS) is used for scheduling the non-critical functions. The quality of service for the non-critical functions is determined by their reserved bandwidth. In addition, a Tabu search-based approach is used for mapping the system functions to hardware nodes. Furthermore, there is a temporal isolation between the critical and non-critical functions. Thus, overruns of the non-critical functions do not affect the timing guarantees of the critical functions, and the quality of service for the non-critical functions is maximized.

Keywords: mixed-criticality; design space exploration, adaptive system; schedulability analysis; model-based.

I. Introduction

With the advances in micro-electronics, embedded system engineers are now able to integrate more system functions on a powerful System-on-Chips (see Figure 1)[1]. The automotive industry also benefits from these advances, where the engineers become able to integrate advanced vehicle functions on high performance electronic control units (ECUs).These functions can be classified as critical and non-critical functions. Thus, mixed-criticality concept has been introduced, where vehicle functions have different criticality levels as shown in Figure 1[2]. In addition, the new Auto SAR adaptive platform makes automotive systems able to adapt themselves at runtime to cope with hardware and software failures [3]. A major challenge is how to map functions of an adaptive systems to its hardware nodes, and to reserve bandwidth for these functions [4].

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In recent years, a number of approaches has been proposed for mapping a system's functions to its processing units, and for reserving their bandwidth to ensure that they are going to meet their deadlines at runtime (e.g. [5] [6] [7] [8] [9]). These approaches are aiming at functions mapping and bandwidth reservation for systems that do not have runtime adaptability. However, the new vehicle systems need to adapt themselves in response to hardware and software failures while they are in operation [10] [11]. To cope with system failures, a number of system configurations need to be specified as reactions to these failures. In addition, functions mapping and their bandwidth reservation in each system configuration need to be defined. Consequently, adopting the existing approaches for specifying a system's different configurations, and defining its functions mapping and their bandwidth reservation is difficult and error-prone task, where these approaches have not been proposed for adaptive systems.

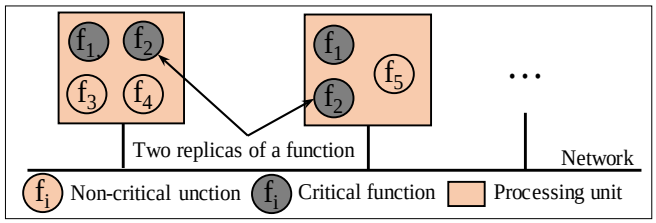

Fig.1: Multiprocessor architecture for a system with mixed critical-functions

In this paper, we propose a model-based approach to ease the specification of the different configurations of an adaptive system, and to identify functions mapping and their bandwidth reservation in each configuration. First, we use EAST-ADL (an architecture description language for automotive embedded systems [12]) for creating the system design model. This model captures the system's functionality, timing requirements, and adaptive behavior. To model the adaptive behavior, we adopted the state machine approach [13]. In this machine, the states are corresponding to the system configurations, and the transitions represent adaptations between these configurations. To capture the timing requirements, we have adopted TIMMO (TIMing MOdel) approach [14].

Second, the system design model is used for identifying the functions allocation and their bandwidth in the different system configurations automatically. To

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schedule critical functions, Earliest Deadline First (EDF) [15]is used, while Constant Bandwidth Server (CBS) [16]is used to schedule non-critical functions. Quality of service for the non-critical functions is determined by their reserved bandwidth. In addition, a Tabu search-based strategy is used to map functions to the hardware nodes[17]. Furthermore, there is a temporal isolation between critical and non-critical functions. Thus, overruns of the non-critical functions do not affect timing guarantees for the critical ones, and the quality of service for the non-critical functions is maximized. To show the applicability of our approach, a case study using it is performed in the context of Safe Adapt project.

The remainder of the paper is organized as follows. A short description of related work is given in Section II. Our approach for designing an embedded system, and for functions mapping and their bandwidth reservation is described in Section III. In Section IV, we present our approach implementation. Finally, we conclude the paper in Section V.

II. Related Work

The work introduced in this paper is related to two research areas: designing adaptive systems, and functions mapping and their bandwidth reservation. In the following, we describe the related work from these two angles.

a) Designing Adaptive Systems

Rainbow framework provides mechanisms for monitoring the environment, performing the analysis of the environment to initiate the adaptation process, selecting the required adaptation strategy, and effecting the needed changes to a running system[18]. To capture the system reactions to environment changes, they used a language called *Stitch*. Sheng et al. have proposed a model-driven approach to ease the development of context-aware web services[19]. In their approach, they consider the system functionality as a single service, and the environment information is used by a set of rules to adapt the service output parameters in response to environment changes.

An approach was introduced by Zhang and Cheng to create formal models of a system behaviour[20]. In this approach, the system adaptive behaviour is separated from its non-adaptive behaviour. This separation makes the system models easier to specify and verify. They used Petri-nets to capture the system's adaptive behaviour, where they use context change as guidance for the transition between system states. The *SOCAM* (Service-Oriented Context-Aware Middleware) project introduces an architecture for building adaptive systems[21]. It uses a central server to gather context information from distributed context providers. This information is then processed, so that it can be used by the system functionality.

MUSIC project is a component-based framework that is used to optimize a system overall utility in response to context changes[22]. They have a quality of service (QoS) model that describes the system composition together with the relevant QoS dimensions, and how they are affected when the system is going to change from one configuration to another. The quality of service model is used for selecting a new configuration that has the best utility and is able to cope with the context changes. Heaven et al. have developed an approach to adapt a system in response to environment changes while preserving its high level goals[23]. They use Labelled Transition Systems (LTS) to capture the system states and the environment situations.

Andrade et al. have proposed an approach to cope with unanticipated changes of an adaptive system behaviour [24]. They separate the system adaptation from its functionality, and represent the adaptation logic as a set of condition-action rules. These rules are constructed as a component-based system that can be changed at runtime. Morin et al. proposed a technique to handle the exponential growth of the number of configurations that are derived from the system variability[25]. They combine model driven and aspect oriented approaches to cope with the complexity of adaptive software systems.

b) Function Mapping and Bandwidth Reservation

A technique that uses Constant Bandwidth Server (CBS) for integrating critical and non-critical functions on the same processor has been introduced by Abeni and Buttazzo [8]. This technique uses scheduling algorithms such as Earliest Deadline First (EDF) or Rate Monotonic (RM) to guarantee meeting the deadlines of critical functions. The non-critical functions are scheduled by a number of servers. A server parameters (i.e., its bandwidth and period) determine the probability of meeting the deadline of a non-critical function (i.e. its quality of service). The approach is also extended to adjust the server parameters by proportional integral derivative (PID) controllers at runtime. The idea behind this is to maximize the QoS of the non-critical functions [26]. Offline and online approaches to derive CBS parameters have been also proposed [27]. They are aiming at increasing the probability of meeting deadlines of the system non-critical functions.

A Tabu search-based algorithm has been introduced for performing functions mapping and their bandwidth reservation [28]. This algorithm considers mixed-critical real-time systems that should tolerate transient faults. It uses EDF to schedule critical functions and CBS to schedule non-critical ones. The faults are tolerated through defining check points with rollback recovery mechanism [29]. It also uses the probability density functions for the non-critical functions. Thus, decisions of the mappings and processor bandwidth allocations are improved.

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In the context of systems that have mixed time triggered (TT) and event triggered (ET) functions, an approach has been introduced [30]. This approach schedules the TT functions by static-cyclic scheduling (SCS), while the ET functions are scheduled using fixed-priority scheduling (FPS). It can be also be extended to constrain the TT schedules by following a given partitioning. The problem of mapping and partitioning have been addressed [31]. However, the partitioning means deciding which functions are TT and which are ET.

Another approach to address the mapping of mixed critical real-time functions on distributed embedded architectureshas been introduced [32]. It assumes that the architecture provides spatial and temporal partitioning. Therefore, enough separation between functions are enforced. In temporal partitioning, each function executes in a separate partition. Each partition is also allocated a set of time slots on a processor (where the function is mapped). Time slots of all functions on a processor are also grouped within a major frame that is repeated periodically. The functions are scheduled using static-cyclic scheduling.

The approaches discussed above are focusing on functions mapping and bandwidth reservation for embedded systems that do not adapt at runtime. However, new vehicle systems need to adapt themselves in response to hardware and software failures with the support of the new Auto SAR adaptive platform [3][10] [11]. To cope with failures of such systems, a number of system configurations need to be specified as system reactions. In addition, functions mapping and their bandwidth reservation for each configuration need to be identified. Therefore, using the existing approaches for specifying the system's different configurations, and identifying the functions mapping and their bandwidth reservation is difficult and error-prone tasks.

III. The Proposed Approach

To ease the process of mapping functions of an embedded adaptive system to its hardware nodes, and for reserving their bandwidth, we have proposeda two-step process. In the first step, a model for the system is specified. This model includes the system's functionality, timing requirements, and adaptive behavior. In step two, based on the system model, mappings of the system functions in each system configuration and their bandwidth are identified by schedule ability analysis techniques. In the following, we describe the two steps in detail.

a) Modelling Adaptive Embedded System

To model a safe adaptive system, three aspects need to be captured: the system functionality, its timing requirements, and its adaptive behavior. The adaptive behavior specifies system reactions to anticipated changes such as hardware failures.

The System Functionality: The system functionality consists of functions that interact with each other to meet user requirements (see Figure 2). To model such functionality, an architecture description language for automotive domain (i.e. EAST-ADL [12]) is used. In EAST-ADL, the architecture is modeled at two levels of abstraction: an abstract functional model and a refined in form of a design model. Both levels are modelled as a composite structure that consists of components that interact with each other through functional ports. In our approach, we use cardinality of system components to specify the system variability. A component with cardinality {0 or 1} is optional while cardinality {2} means it has two instances and the system can switch between them at runtime. A cardinality {1} specifies that the component is mandatory and should always exist while the system is in operation (i.e. permanent).

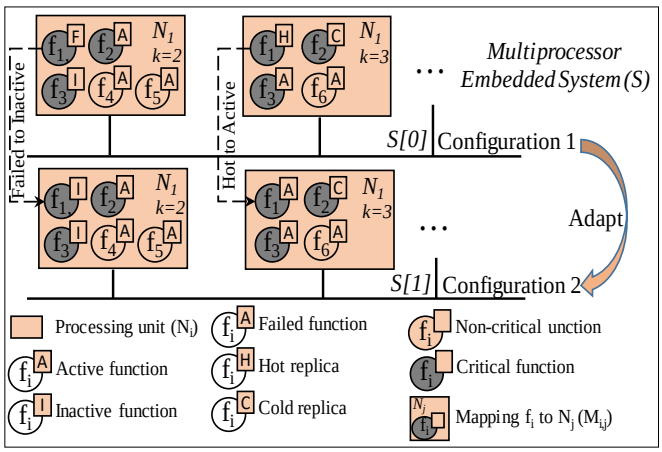

Fig. 2: A representation of an adaptive embedded system

A component may have two instances to increase the system availability and to ensure that the functionality of this component is always provided [33]. These two instances need to be allocated to different processing units, so that a failure does not lead to a total failure of the functionality (e.g. function f_1 in Figure 2). To specify such allocation, the system hardware need to be modelled and the functional allocation can be then defined. Similar to the system functions, the hardware model is specified using EAST-ADL modelling language. It is modelled a composite structure that contains the hardware elements such as processing units, sensors, actuators, etc.

The System Timing Requirements: To model the system's timing requirements, we have adopted the technique proposed in TIMMO-2-USE [14] (TIMing MOdel - TOols, algorithms, languages, methodology, and USE cases) project. To specify a timing requirement, events that are associated with a software function or

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one of its ports are defined. These events are then used for defining timing constraints such as execution time constraint, periodic constraint, reaction constraint, etc. Using TIMMO, the execution time of a function is specified by the Execution Time Constraint concept where the start and the stop events of the function are defined with lower and upper bound for the delay between them (see Figure 3). Similarly, to specify a periodic constraint, an event that is associated with a function is defined. Then, the Periodic Constraint concept is used, where a periodic constraint is specified that references this event. This constraint specifies the inter-arrival time and the period of a function (e.g. 60 milliseconds).

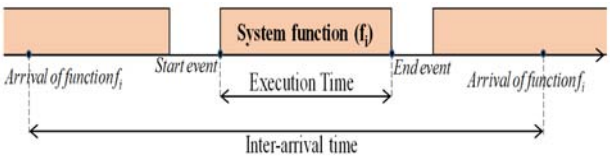

Fig. 3: Representation of timing constraintsof a function f_i

The System Adaptive Behavior: To adapt the embedded system in response to context changes, we introduce a system management component [34]. This component switches from a system configuration to another in response to an adaptation trigger (e.g. a failure of the function f_1 as shown in Figure 2). Therefore, we need to model adaptation triggers and different runtime configurations (states) of the system. Both represent a runtime system state. To model a system state, we adopted the concept of UML instance specifications where a system design instance (i.e. the system's functionality and hardware platform) is created and configured to specify a system runtime state or an adaptation trigger [35].

In order to model an adaptive behavior of a system, we adopted the state machine approach [13]. This technique makes adaptation policies easy to understand and it is useful for validation and verification purposes. In this machine, states are corresponding to the system configurations, while transitions represent the adaptations between these configurations. Each transition is guarded and triggered by an adaptation event. For example, in response to a function failure during a specific state, the system moves from its state or to a configuration that recovers from this failure as shown in Figure 2.

b) Task Mapping and Bandwidth Reservation

To identify functions mapping and bandwidth reservation of an embedded system, the design model is used as a base for doing that (i.e. Step 2). In the following, we first describe the formulation of functions mapping and bandwidth reservation problem. Then, we describe an approach to solve this problem.

The problem can be formulated as follows. Given a mixed critical system (S), and a distributed architecture (N) with a maximum number of transient faults (k) (an example system is shown in Figure 2). We are interested in determining a solution (L) consisting of a mapping M (f_i) ∈ N for each function f_i∈ S, and a set B containing the bandwidth $B_i$for each function f_i. Thus, the deadlines for critical functions are satisfied even in the case of transient faults. In addition, the probability for meeting the deadlines of non-critical functions is maximized.

To solve the above problem, we have used a Tabu search-based strategy. Tabu search is an optimization metaheuristic [17]. It explores iteratively solutions in the neighbourhood of current solution to select a solution that minimizes the cost function. The cost function we use (described later) captures schedulability of critical functions and quality of service (QoS) of non-critical functions. The minimization of the cost function aims to improve schedulability of the critical functions and to maximize the QoS for the non-critical functions.

Our Tabu search-based strategy is described in Table 1 (an extension for the algorithm described in [28]). The input is an adaptive system model in a form of configurations as described above (S), the hardware nodes (N), and maximum number of iteration for our strategy (MaxI). The output of the algorithm is a number of solutions (L) for the system configurations. The solutions consist of functions mapping M, and the set of bandwidth B for all critical and non-critical functions in each system configuration.

Table 1: Tabu search-based strategy for task mapping and bandwidth reservation

Input: S: Adaptive system, N: Distributed architecture, MaxI: Maximum number of iterations.

Strategy:

1: c = 0;
2: ***foreach*** configuration C: S[c] ***do***
3: ***if*** (c > 0) L_0 = GenerateInitialSolution (L[c-1]);
4: ***else*** L_i= GenerateInitialSolution(S[c], N);
5: ***end if***
6: $L_{current}$ = L_{best} = L_0;
7: $Cost_{best}$= CostFunction(L_0);
8: TabuList = ***new*** List;
9: ***While*** iter < MaxI or $Cost_{best}$== 0 ***do***
10: NL = GenerateNeighborhood(L_{best});
11: $L_{current}$= SelectSolution(NL);
12: ***if*** Cost Function($L_{current}$) <$Cost_{best}$ ***then***
13: $Cost_{best}$= CostFunction($L_{current}$);
14: L_{best}= $L_{current}$;
15: ***end if***
16: Add ($L_{current}$, TabuList);
17: ***end while***
18: L[c] =L_{best};
19: c = c+1;
20: ***end for***

Output: L: Solutions for the system configurations

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Our strategy starts by generating an initial solution L_0(see Table 1: Line 3-4). In this solution, the functions are allocated randomly to the hardware nodes, and critical tasks are assigned a bandwidth equals to their worst case execution time (WCET) while the non-critical functions assigned a bandwidth equals to their average execution time (AET). The initial solution can be schedulable or not. A schedulable solution is the one that all critical functions meet their deadlines. The initial solution is used as a starting point in finding a better solution for a system configuration (state). However, in the case of it is not the first state, an initial solution is generated that takes into account the previous solution as shown in Table 1: Line 4.

The strategy then starts to search the neighbourhood of the current solution for finding a better solution. New solutions are generated either by changing functions mappings or through increasing/reducing the bandwidth of the non-critical functions. The neighbourhood can be very large. Thus, we only consider a limited number of solution in each iteration. The generated solutions are evaluated by computing their costs. The one with the lowest cost is then selected as current solution (Lines 9-16 in Table 1). This process is repeated until maximum number of iterations is reached or the cost becomes zero. After finding a solution for a system configuration, the strategy is repeated for finding solutions for other system states which is the output of our strategy.

One feature of Tabu-search based techniques is the storage of solutions history that are visited (called *Tabu List* in our strategy). The idea behind this list is to avoid revisiting already explored solutions. The solutions history is initialized in Line 8 of our strategy, and updated with the currently visited solution at Line 16.

To compute the cost of a solution, schedulability analysis for critical and non-critical functions needs to be calculated. In the following, we describe these calculations in detail.

Schedulability Analysis for Critical Functions: To analyse schedulability of the critical functions and content bandwidth servers for the non-critical functions (describe below), we use a utilization-based test. The utilization of a hardware node N_j is computed by Equation 1 (below)[36]. In this equation, first, $C`_i$ is worst case execution time (WCET) of a critical function f_i allocated to the hardware node N_j. To compute the WCET while considering failures possibility, we use a number of checkpoints (n_i) together with checkpoints overhead (o_i), error detection overhead (e_i), and the function's execution time as shown in Figure 4-A: $C`_i = C_i + (n_i - 1)(o_i + e_i) + e_i$ [28].

$$\sum_{\substack{\forall f_i : R(f_i)=Critical \\ \wedge M_j(f_i)=N_j}} \frac{C_i^{'}}{T_i} + \sum_{\substack{\forall f_i : R(t_i)=Non-critical \\ \wedge M_j(f_i)=N_j j}} \frac{B_i}{T_i} + U_R^{N_j} < 1 \qquad (1)$$

Second, T_i is the deadline for a critical or a non-critical function f_i. Third, B_i is the bandwidth that is allocated to a non-critical function. Forth, when a fault occurs during the execution of a function f_i, this function has to be restored from a previously saved checkpoint. Also, an execution segment of length (C_i/n_i) needs to be executed. Therefore, the utilization needed for recovering from a fault is $((C_i/n_i) + e_i + m_i)/T_i$, where m_i is the time required to recover from the error. For a processing unit N_j that can have up to k failures during the system execution, its utilization can be computed following Equation 2[28]. In this equation, the utilization is determined for recovery critical functions. In addition, the worst-case is the occurrence of the k faults, which is corresponding to largest recovery utilization.

$$U_R^{N_j} = \max_{\substack{f_i : R(f_i)=Critical \\ \wedge F(f_i)\neq\phi}} k \times \frac{(C_i / n_i) + e_i + m_i}{T_i} \qquad (2)$$

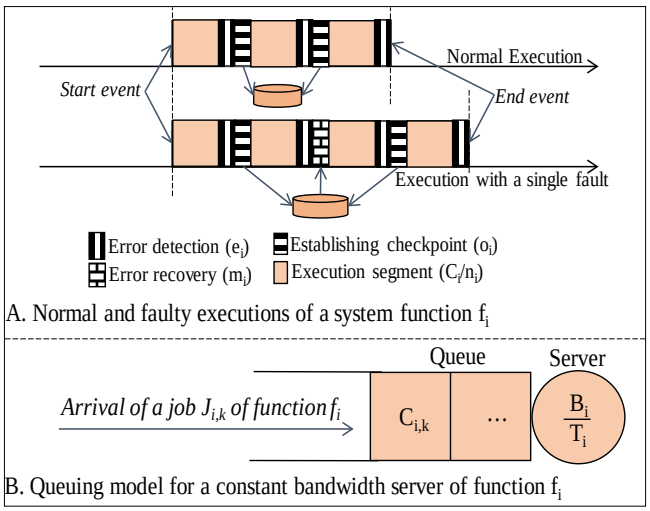

Fig. 4: Execution of a function f_i and a queuing model for its constant bandwidth server

Schedulability Analysis for Non-critical Functions: The schedulability analysis of non-critical functions is probabilities of meeting their deadlines (i.e. their quality of service (QoS)). These probabilities depend on the allocated bandwidths B for them. Because of the temporal isolation property of Constant Bandwidth Server, each non-critical function can be analysed individually. Also, the computation of the system functions' QoS is expensive, and then they are computed and stored to be later used by our strategy.

For a non-critical function f_i, the QoS (f_i) is defined as the probability of meeting its deadline d_i which is P $\{ft_{i,k} \leq rt_{i,k} + d_i\}$. The $ft_{i,k}$ and $rt_{i,k}$ are the finishing and the arrival time of the k^{th} job of the function. To calculate this probability, a CBS that serves the function f_i is modelled as a queuing system [37]. The function jobs J_i are seen as tokens that need to be served by the server having the capacity $B_i$as shown in

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Figure 4-B. A Markov matrix is then built and its steady state probability is computed to determine the probability of meeting the deadline of f_i when its allocated bandwidth is B_i (for more detail about these calculations, see [26] and [38]).

In our approach, we consider values of a bandwidth in the interval [*AET, WCET*]. In the case of $Bi \geq WCET$, the deadline will be met in 100% of the cases, while if $Bi < AET$, the probability of meeting the deadline is very small.

Cost Function: In our strategy, the solutions are evaluated based on a cost function that needs to be minimized. The cost function for a solution L is computed using Equation 3. The weight ($w_{penalty}$) is corresponding to a very large penalty added when a critical function is not schedulable (i.e. utilization of a hardware node is more than 1). If critical tasks are schedulable, the first part of the equation is 0. The second part of the cost function is corresponding to maximizing the QoS of the non-critical functions. For each function, a weight (w_i) is assigned to differentiate these functions in terms of their importance.

$$\sum_{\forall N_i \in N} \max(0, U_{N_i} - 1) \times w_{penalty} + \sum_{\substack{\forall f_i : R(f_i) = \\ Non-critical}} (1 - QoS(f_i)) \times W_i \quad (3)$$

IV. Implementation

In this Section, we use the concepts previously explained in Section III to model an adaptive vehicle system, and to identify its functions mapping and their bandwidth reservation. We also describe the tool that supports our approach. This case study has been done in the context of the Safe Adapt project [39].

a) Modelling an Adaptive Vehicle System

As discussed previously to model an adaptive system, there is a need for specifying its functionality, timing requirements, and adaptive behavior. In the following, we discuss the design model of an adaptive vehicle system.

Modelling System Functionality: To design an adaptive vehicle system following our approach, we use the Papyrus UML modeler [40]. Part of the system's functional model is shown in Figure 5. The model consists of a set of functions that are linked with each other through functional ports. In Figure 5, the full adaptive cruise control has the cardinality {2} that means it has two instances. The two instances can replace each other at runtime in case of one's failure. The SomnoAlert is an optional function, i.e., it can exist or not while the system is in operation (the cardinality is {0 or 1}).

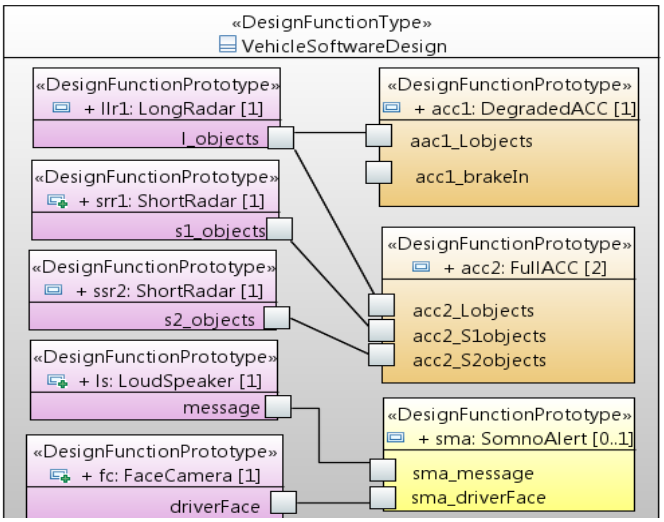

Fig. 5: Part of the design model for an embedded adaptive vehicle system

Similar to the functional model, a hardware model of the system is also designed as a composite structure that consists of two electronic control units (i.e. Delphi TMDP (Trusted Multi Domain Platform) and RACE [41]). In addition, the two units are connected with each other by a hardware connector. The number of failures is also specified for these control units (e.g. "*k = 2*").

Modelling the System Timing Requirements: To model the system timing requirements, we have used TIMMO modelling. For the adaptive vehicle system, a number of constraints have been defined. Some of them are presented in Figure 6. First, to specify a periodic constraint, an event associated with the full cruise control (FullACC) function is defined (i.e. FACCEvent). Then, a periodic constraint is specified that reference this event (see Figure 6). The FullACC function has a minimum inter-arrival time and period of 300 milliseconds. Second, execution time (i.e. 50 milliseconds) of the steering controller function is defined based on the event (SCEvent) as shown in Figure 6.

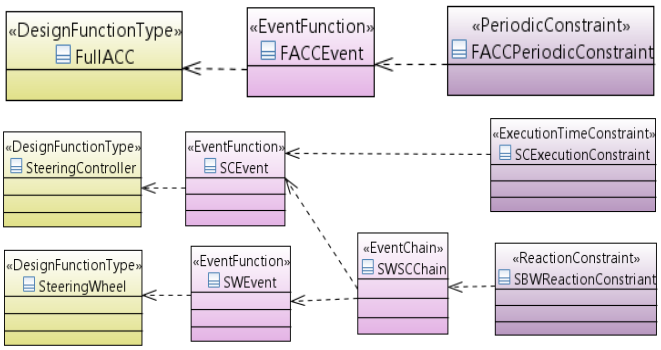

Fig. 6: Example of timing requirements

Using our tool, the different information needed to execute our strategy for functions mapping and bandwidth reservation can be easily defined. For

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example, number of checkpoints, checkpoints overhead, and time of error detection and recovery can be specified as attributes of a UML class that represents a system function.

Modelling the System Adaptive Behavior: To model the adaptive behavior of the system, both adaptation triggers and system configurations need to be specified. We model both of them using the instance specification concept. A set of UML in stance specifications that describe component instances along with values for their attributes. Such a set is called deployment plan, a term inspired from the CORBA component model[42]. In our approach, a deployment plan represents a system trigger or configuration (state).

An example of an adaptation trigger modeled as an instance specification is shown in Figure 7 (see the top part). For each function, a runtime state is defined {e.g. Active, Inactive, Hot, Cold, and Failed}. In this example: BBW0, SMA, ACC0, and AEB are in "Active" state, SBW1 is "Hot", BBW1 and ACC1 are in "Cold" state, and SBW0 is "Failed". A system state to recover from the failure of SBW0 is shown in Figure 7 (bottom part). The instance specification for each function is defined as *<Function Name, and State>*. Therefore, this configuration is defined as follows:

{<SBW0, Inactive>, <SBW1, Active>, <BBW0, Active>, <BBW1, Cold>, <SMA, Active>, <ACC0, Active>, <ACC1, Cold>, <ACC2, Hot>, <AEB, Active>}

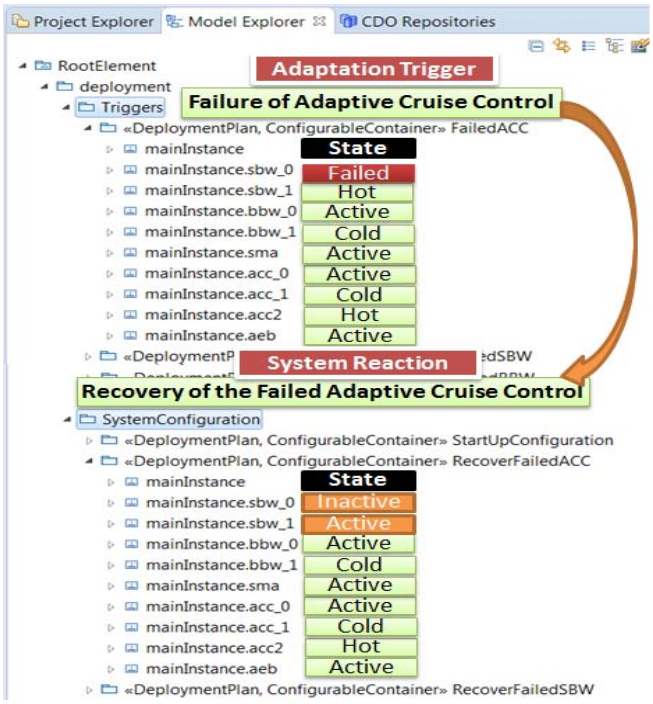

Fig. 7: Specifying an adaptation trigger and a system response

To model the switching between the system configurations in response to the adaptation triggers, a state machine is created as shown in Figure 8. For example, in response to a failure of the steer-by-wire (the adaptation trigger specified on top part of Figure 7), the system adapts from its initial configuration to another that recovers this failure (i.e. the system configuration shown in the bottom part of Figure 7). This system switching is specified using the fourth transition shown in Figure 7 (i.e. "Failure of SBW1"). In this transition, the state of the first instance of the SBW is changed from "Failed" to "Inactive", while the state of the second instance of the SBW is changed from "Hot" to "Active".

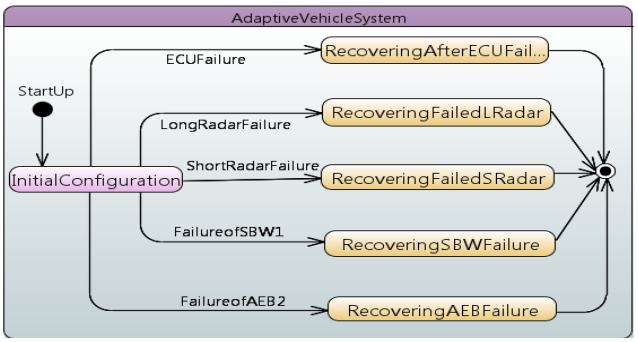

Fig. 8: Adaptive behavior for the vehicle system

b) Task Mapping and Bandwidth Reservation

Based on the timing information specified into the design model (see above), our tool (which implements the strategy described in previous section) finds the allocation and required bandwidth for each system function. An example screenshot of the tool is shown in Figure 9. It determines the allocation for each function. For example the degraded ACC is allocated on TMDP control unit. It also finds the required bandwidth for the degraded ACC which is "53" with QoS of 100% probability of meeting its deadline. The tool also shows how many iterations (e.g. 12) and how long (e.g. 64 millisecond) it takes to find the allocations and to determine the bandwidth reservation.

A main feature of our approach is the consideration of all configurations in identifying the function mappings. Thus, our approach improves existing techniques (e.g. Saraswat et al. [28]), where we find allocations that reduce (limit) the changes of function allocation from a configuration to another as shown in Figure 10. Therefore, at runtime, functions re-allocation is reduced or restricted (if possible), while achieving the best quality of service for the non-critical functions.

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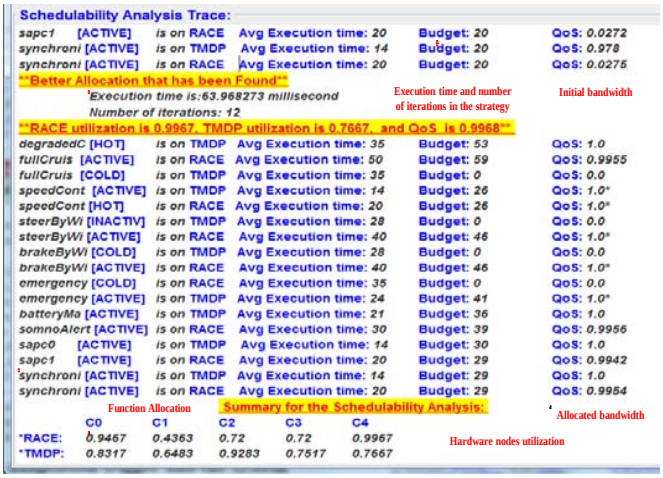

Fig. 9: Output of the strategy for bandwidth reservation

Using Saraswat et al. Approach

	C0	C1	C2	C3	C4
*RACE:	0.93	0.45	0.7133	0.7133	0.93
*TMDP:	0.835	0.5517	0.8367	0.665	0.835
*QoS :	1.0	1.0	1.0	1.0	1.0

**Applications Allocation in the Different Configurations:

	C0	C1	C2	C3	C4
degradedCruis	TMDP	RACE	TMDP	RACE	TMDP
fullCruiseCon	RACE	TMDP	RACE	TMDP	RACE
fullCruiseCon	TMDP	RACE	TMDP	RACE	TMDP
speedControl0	TMDP	RACE	RACE	TMDP	TMDP
speedControl1	RACE	TMDP	TMDP	RACE	RACE
steerByWire0	TMDP	TMDP	RACE	TMDP	RACE

Using our approach

	C0	C1	C2	C3	C4
*RACE:	0.95	0.4329	0.7267	0.7267	0.9967
*TMDP:	0.8283	0.645	0.925	0.7517	0.7633
*QoS :	1.0	1.0	1.0	1.0	1.0

**Applications Allocation in the Different Configurations:

	C0	C1	C2	C3	C4
degradedCruis	TMDP	TMDP	TMDP	TMDP	TMDP
fullCruiseCon	RACE	RACE	RACE	RACE	RACE
fullCruiseCon	TMDP	TMDP	TMDP	TMDP	TMDP
speedControl0	TMDP	TMDP	TMDP	TMDP	TMDP
speedControl1	RACE	RACE	RACE	RACE	RACE
steerByWire0	TMDP	TMDP	TMDP	TMDP	TMDP

Fig. 10: Output of our strategy for function allocation in each system configuration

V. Conclusion

The new AutoSAR adaptive platform makes mixed-critical automotive systems able to adapt themselves at runtime to cope with hardware/software failures. However, mapping functions of these automotive systems and reserving bandwidth for them are still major challenges. In this paper, we proposed a model-based approach for specifying different configurations of an embedded adaptive system, and for defining functions mapping and bandwidth reservation in each system configuration. First, we have used EAST-ADL to create the system design model. This model captures the embedded system functionality, timing requirements, and its adaptive behavior. Second, the system's design model is used as a base for finding functions allocation and for reserving their bandwidth in the different system states (configurations). To schedule the critical functions, the Earliest Deadline First (EDF) is used, while the Constant Bandwidth Server (CBS) is used for scheduling the non-critical functions. Finally, to show our approach applicability, in the context of the Safe Adapt project, a case study has been conducted.

As future work, we plan to extend our approach to enable code generation from the system design model, and automatic deployment of the generated system functions to its hardware nodes. Further evaluations will also be carried out to assess the approach robustness by applying it to a number of case studies.

References

1. U. Abelein, H.Lochner, D. Hahn, and S. Straube, "Complexity, quality and robustness - the challenges of tomorrow's automotive electronics," in Design, Automation, Test in Europe (DATE), Dresden, Germany, 2012, pp. 870-871.
2. Izosimov, P. Pop, P. Eles, and Z. Peng, "Scheduling of fault-tolerant embedded systems with soft and hard timing constraints," in Proceedings of Design, Automation & Test in Europe DATE '08, 2008, pp. 915–920.
3. S. Furst., "AUTOSAR the Next Generation – The Adaptive Platform," in CARS@EDCC 2015, Paris, France, 8th September 2015.
4. A. Burns and R. Davis, "Mixed criticality systems-a revie," Department of Computer Science, University of York, Tech. Rep, pp. 1–69, Januray 2017. [Online]. http://www-users.cs.york.ac.uk/burns/review.pdf
5. P. Sahu, S. Chattopadhyay, "A survey on application mapping strategies for Network-on-Chip design," ournal of Systems Architecture, vol. 59, no. 1, pp. 60-76, January 2013.
6. S. Manolache, P. Eles, and Z. Peng, "Task mapping and priority assignment for soft real-time applications under deadline miss ratio constraints," ACM Transactions on Embed. Comput. Syst, vol. 7, no. 2, pp. 1-35, 2008.
7. N. Zamora, X. Hu, and R. Marculescu, "System-level performance/power analysis for platform-based design of multimedia applications," ACM Transactions on Design Automation of Electronic Systems, vol. 12, no. 1, 2007.
8. L. Abeni and G. Buttazzo, "Integrating multimedia applications in hard real-time systems," in roceedings of 19th IEEE Real-Time Systems Symposium, 1998, pp. 4-13.
9. S. Chakraborty and L. Thiele, "A new task model for streaming applications and its schedulability analysis," in Proceedings of Design, Automation and Test in Europe DATE'05, 20005, pp. 486–491.
10. P. Schleiss, M. Zeller, G. Weiss, and D. Eilers, "Safe Adapt: Safe Adaptive Software for Fully Electric Vehicles," in 3rd Conference on Future Automotive Technology (CoFAT), 2014.

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11. M. Hussein, R. Nouacer, A. Radermacher, "A Model-driven Approach for Validating Safe Adaptive Behaviors," in 19th Euromicro Conference on Digital Systems Design (DSD 2016), Limassol, Cyprus, August 31 – September 2, 2016.
12. D.J. Chen, S. Gerard, H. Lonn, M.O. Reiser, D. Servat, C.J. Sjostedt, R.T. Kolagari, M. Torngren, and M. Weber P. Cuenot, "Managing Complexity of Automotive Electronics Using the EAST-ADL," in 12th IEEE International Conference on Engineering Complex Computer Systems (ICECCS '07), Washington, DC, USA, 2007, pp. 353-358.
13. B. Morin, O. Barais, J.M. Jezequel, F. Fleurey, and A. Solberg, "Models@ Run. Time to Support Dynamic Adaptation," Computer, vol. 42, pp. 44-51, 2009.
14. O. Scheickl, M. Rudorfer, "Automotive Real-Time Development Using Timing augmented AUTOSAR Specification, BMW Car IT," in 4th European Congress Embedded Real-Time Software (ERTS 2008), Toulouse, France, January 29 - February 1, 2008.
15. M. Andrews, "Probabilistic end-to-end delay bounds for earliest deadline first scheduling," Proceedings IEEE INFOCOM 2000. Conference on Computer Communications," in Nineteenth Annual Joint Conference of the IEEE Computer and Communications Societies, Tel Aviv, 2000, pp. 603-612.
16. G. Lipari and S. Baruah, "2001. A Hierarchical Extension to the Constant Bandwidth Server Framework," in Proceedings of the Seventh Real-Time Technology and Applications Symposium (RTAS '01), 2001.
17. F. Glover and M. Laguna, Tabu Search. Norwell, MA, USA: Kluwer Academic Publishers, 1997.
18. D. Garlan, S. Cheng, A. Huang, B. Schmerl, and P. Steenkiste, "Rainbow: Architecture-Based Self-Adaptation with Reusable Infrastructure," Computer, vol. 37, no. 10, October 2004.
19. Q. Z. Sheng, J. Yu, A. Segev, K. Liao, "Techniques on developing context-aware web services," Int. Journal of Web Information Systems, vol. 6, no. 3, pp. 185-202, 2010.
20. J. Zhang and B. H. C. Cheng, "Model-based development of dynamically adaptive software," in the 28th international conference on Software engineering, Shanghai, China, 2006.
21. T. Gu, H. K. Pung, and D. Q. Zhang, "A service-oriented middleware for building context-aware services," J. Netw. Comput. Appl., vol. 28, pp. 1-18, 2005.
22. R. Rouvoy, P. Barone, Y. Ding, F. Eliassen, S. Hallsteinsen, J. Lorenzo, A. Mamelli, and U. Scholz, "MUSIC: Middleware Support for Self-Adaptation in Ubiquitous and Service-Oriented Environments," Software Engineering for Self-Adaptive Systems, vol. LNCS 5525, pp. 164-182, 2009.
23. W. Heaven, D. Sykes, J. Magee, and J. Kramer, "A Case Study in Goal-Driven Architectural Adaptation," Software Engineering for Self-Adaptive Systems, vol. LNCS 5525, pp. 109-127, 2009.
24. S. S. Andrade and R. J. de Araujo Macedo, "A non-intrusive component-based approach for deploying unanticipated self-management behaviour," in Software Engineering for Adaptive and Self-Managing Systems (SEAMS '09), 2009.
25. B. Morin, O. Barais, G. Nain, and J. Jezequel, "Taming Dynamically Adaptive Systems using models and aspects," in the 31st International Conference on Software Engineering, 2009.
26. L. Abeni, L. Palopoli, G. Lipari, and J. Walpole, "Analysis of a reservation-based feedback scheduler," in Proceedings of 23rd IEEE Real-Time Systems Symposium, 2002, pp. 71-80.
27. A. Oliveira, E. Camponogara, and G. Lima, "Dynamic reconfiguration in reservation-based scheduling: An optimization approach," in Proceedings of 15th IEEE Real-Time and Embedded Technology and Applications Symposium, 2009, pp. 173–182.
28. P. Kumar Saraswat, P. Pop, and J. Madsen, "Task Mapping and Bandwidth Reservation for Mixed Hard/Soft Fault-Tolerant Embedded Systems," in 16th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS '10), 2010.
29. P. Pop, V. Izosimov, P. Eles, and Z. Peng, "Design optimization of time and cost-constrained fault-tolerant embedded systems with check pointing and replication," IEEE Transactions on VLSI Systems, vol. 17, pp. 389-402, 2009.
30. T. Pop, P. Pop, P. Eles, Z. Peng, and A. Andrei, "Timing analysis of the Flex Ray communication protocol," Real-Time Systems, vol. 39, no. 1, pp. 205-235, 2008.
31. P. Pop, P. Eles, Z. Peng, and T. Pop, "Analysis and optimization of distributed real-time embedded systems," ACM Transactions on Design Automation of Electronic Systems (TODAES), vol. 11, no. 3, pp. 593-625, July 2006.
32. D. Tămaş-Selicean and P. Pop, "Design Optimization of Mixed-Criticality Real-Time Embedded Systems," ACM Trans. Embed. Comput. Syst., vol. 14, no. 3, pp. 1-29, April 2015.
33. R. France, and B. Rumpe, "Model-driven Development of Complex Software: A Research Roadmap," in Future of Software Engineering (FOSE 2007), Minneapolis, MN, USA, 2007, pp. 37-54.
34. M. Salehie, and L. Tahvildari, "Self-adaptive software: Landscape and research challenges," ACM Trans. Auton. Adapt. Syst, vol. 4, no. 2, pp. 1-42, 2009.

© 2018 Global Journals

35. M. Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language (3 ed.).,", Boston, MA, USA, 2003.
36. H. Kopetz, Real-Time Systems: Design Principles for Distributed Embedded Applications: Kluwer Academic Publishers, 1997.
37. L. Abeni and G. Buttazzo, "Stochastic analysis of a reservation based system," in Proceedings of 15th International Parallel and Distributed Processing Symposium, 2001, pp. 946–952.
38. L. Abeni, G. Lipari, and J. Lelli, "Constant bandwidth server revisited," ACM SIGBED Review - Special Issue on the 4th Embedded Operating Systems Workshop, vol. 11, no. 4, pp. 19-24, January 2015.
39. SafeAdapt: Safe Adaptive Software for Fully Electric Vehicles. [Online]. http://www. safeadapt.eu/
40. S. Gérard, C. Dumoulin, P. Tessier, and B. Selic, "Papyrus: A UML2 tool for domain-specific language modeling," in International Dagstuhl conference on Model-based engineering of embedded real-time systems (MBEERTS'07), Berlin, Heidelberg, 2007, pp. 361-368.
41. RACE: Robust and Reliable System Architecture for Future eCars. [Online]. http://www.projekt-race.de/
42. N. Wang, D. Schmidt, and C. O'Ryan, "Overview of the CORBA component model," in Component-based software engineering. Boston, MA, USA: Addison-Wesley Longman Publishing Co., Inc., 2001, pp. 557-571.

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The Effect of using Excessive Oil – Gasoline Mixture on the Acceleration of Bajaj Rickshaw Vehicles

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It was found that oil - fuel mixture ratios which lie between 2% and 5% are the most suitable ratios that could be used by rickshaw drivers and technician mechanics. These ratios are recommended to be used because they give the vehicle's engine higher acceleration, longer operation period life, diverge the overhaul maintenance period intervals, and that they cause less impact to the surrounding environment.

Keywords: *excessive oil; acceleration; bajaj rickshaw; experimental results; pollution impact.*

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Keywords: excessive oil; acceleration; bajaj rickshaw; experimental results; pollution impact.

I. Introduction

Rickshaw began as a two or three - wheeled passenger cart, called a pulled rickshaw, generally pulled by one man with one passenger. The first known use of the term was in 1887. Over time, cycle rickshaws, auto rickshaws, and electric rickshaws were invented [1]. Pulled rickshaws created a popular means of transportation, and a source of employment for male laborers, within Asian cities in the 19th century. Their appearance was related to newly acquired knowledge of ball bearing systems. Their popularity declined as cars, trains and other means of transportation became widely available. Auto rickshaws are becoming more popular in some cities in the twenty first century as an alternative to taxis because of their low cost of fuel and maintenance.

The word rickshaw originates from the Japanese word Jinrikisha, which literally means human powered vehicle [2]. There are several theories about its invention, which may be summarized into the following points:

i. It was invented in Japan in 1869 by Izumi Yosube, who formed a partnership with Suzuki Tokujiro and Taka Yama Kousbe to build the vehicles, having being inspired by the horse carriages that had been introduced to the streets of Tokyo a few years earlier{[3] – [8]} .

ii. An American missionary to Japan called Jonathan Scobie is also said to have invented the rickshaw around 1869 to transport his wife through the streets of Yokohama {[9] – [11]} .

iii. An American blacksmith called Albert Tolman is said to have invented the rickshaw in 1846 in Worcester, Massachusetts for a South American bound missionary [12].

iv. In New Jersey, the Burlington County Historical Society claims an invention in 1869 by carriage maker James Birch, and exhibits a Birch rickshaw in its museum [13].

Though the origins of rickshaw are not entirely clear, they seem to be Japanese, and of Tokyo specifically. The most widely accepted theory offers the name of the past mentioned four inventors, and gives the year of 1869 as the date of invention [3].

In the last quarter of the 19th century the rickshaw was spread all over Asia to Singapore (1880), China (1873) [4], and {[14] – [16]}. In the 20th century, the rickshaws were introduced To Durban city in South Africa, Kenya, Tanzania, Sudan and other areas of East Africa for short distance trips {[17] – [22]}. The 21st century has seen resurgence in rickshaws, because they are about 1/3 to 1/2 the cost of regular taxis. Therefore, they were spread all over the world to Asia, Africa, America, and Europe {[23] – [26]} .

India is home to three quarters of the world's auto rickshaws, which are three - wheeled engine vehicles that are hired to move both people and goods .These vehicles play an important role in urban transport in the country, being used for a wide range of trip purposes, often for trips that cannot be practically undertaken on the other types of public transport, at a considerably lower cost that would be incurred in a taxi.

II. Safety Risks in Riding Rickshaws

Auto rickshaws are perceived to be unsafe, first because the vehicle itself is seen as hazardous and the drivers as poor vehicle operators, who are willing to overload their vehicles and at the same time make many trips in short periods of time.

Auto rickshaws are seen as unstable and liable to turn turtle, due to a shunt from another vehicle, a bump in the road, or overly rapid speeds caused by the

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drivers, with the passengers being thrown against the sparse, hard metal interior, whose sole soft surfaces are the rear passenger bench and the driver's seat. The lack of doors means that the occupants could be thrown onto the road, with the potential for serious injury, even at low speed.

III. Air Pollution and Environmental Impacts

Auto rickshaws have been seen as significant contributors to urban air pollution, and regrettably it is not included in policy making circles in Sudan. The rates of pollutants leaving the exhaust pipe including carbon dioxide, carbon monoxide and unburned hydrocarbons contribute negatively in human beings health in different forms of diseases ranging from chest infections to cancer {[27] – [28]} .

Auto rickshaws are thought to cause congestion in near future due to the impact of their increasing numbers and therefore, major cities would be prone to lungs related diseases and other dangerous impacts related to animals and natural environment surrounding these cities. Therefore, major cities must strictly regulate and rationalize the number of auto rickshaws through a permit system, based on the belief that auto rickshaw numbers would otherwise reach a level that would cause intolerable congestion which leads to serious human and environmental impacts.

The perceptions of auto rickshaws amongst the middle classes, media, consumer organizations and policy makers are largely negative. The vehicles are seen as polluting, unsafe, and a significant cause of congestion and environment degradation. Auto rickshaws are perceived as an intrusion into organized urban space and therefore, they should be tamed and controlled with strict policies and punitive penalties.

As stated above the two stroke gasoline engine driven vehicles are major source of air pollution by their smoky emissions particularly in Asia and Africa. An immediate ban on gasoline - powered two stroke engine vehicles would be extremely difficult and costly because these vehicles are numerous and popular. Two immediate simple solution proposals which include use of correct mixture of lubricant oil to fuel and regular vehicle preventive and corrective maintenance, which ultimately will improve air quality and increase the operation life of the vehicle [29] and [30].

IV. The Usage of Auto Rickshaw in Sudan

Auto rickshaw which also called tuk tuk is used extensively in different parts of Sudan (i.e. urban and non - urban regions) as a mean of transport for short distance trips. These small size vehicles constitute about one - third of all transport population in Sudan according to the statistical records of Sudan National Statistical Bureau.

In Sudan there is a high misunderstanding of the correct mixture of oil to fuel among technicians and vehicles' mechanics and vehicles' drivers as they think that the engine will give its highest performance due to the increase of oil - fuel ratio. The oil - fuel proportion recommended by those technicians and/ or mechanics may reach more than 12%. That means they do not abide with the operation instructions of the manufacture's manual. The manufacturer always recommends that for every liter of gasoline (i.e. Benzene) charged, a lubrication oil proportion of about 2% or 3% should be added to the fuel and should be agitated and mixed perfectly before engine's operation. To do this job, always the rickshaw is equipped with a calibration cup which has two graduated scales engraved on the outside surface of the cup. One of the graduated scales represents the proportion of 3% oil to Benzene, which ought to be used in summer season when the atmospheric temperature is high and therefore, the evaporation rate of the mixture is elevated. The other graduated scale of 2% is recommended to be used during winter when the atmospheric temperature is low and so the evaporation rate. Often, the incorrect mixture of oil to fuel (i.e. more than 5%) is detriment on the performance of the engine due to the increase and accumulation of carbon deposits inside the combustion chamber which minimize the size of the chamber and consequently cause a considerable drop in pressure and power of the engine. The carbon deposits formed during combustion may be inserted and consequently reciprocate between the piston and cylinder. This action causes scratches on the surface of the cylinder and leads repeatedly to engine overhaul maintenance.

Also, the increase of lubrication oil in the oil - fuel mixture causes major defects in spark plug terminal gap which in turn needs repeated and continuous maintenance or replacement of the defected plugs. Another limitation of excessive oil in the mixture is the formation of layers of carbon particles which blocks the exit of exhaust gases through the exhaust pipe, and this problem leads to a considerable drop in exhaust gases pressure and consequently, the exhaust gases are imprisoned inside the cylinder.

V. The Experimental Results on Bajaj Rickshaw Engine

Some experiments on Bajaj Rickshaw engine have been performed using a wide spectrum of oil/ fuel ratios ranging between 2% and 12.5%.

A Bajaj Rickshaw engine of the following technical specifications has been used in the experiments. The specifications are tabulated in table (1) below:

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Table 1: Technical Specifications of Bajaj Rickshaw used in Experiments

Engine	Gasoline Engine, 1 Cylinder, Capacity 400 cc
Speed Transmitter	Manual , 4 Speeds
Battery	12 Volt
Output Power	5.5 hp at 500 rev / min
Maximum Torsional Torque	12.17 N.m at 3500 rev / min
Fuel System	Carburetor System
Ignition System	Electronic Inition (CDI)
Engine Cooling	Air Cooling
Transmission	4 Forward Gears and 1 Reverse Gear
Brake System	Hydraulic Expansion Shoe Brake Front and Rear
Fuel Tank Capacity	8 Liter including 0.75 Liter for the Reservoir Tank
Vehicle Length	2.62 m
Vehicle Breadth	1.3 m
Height above Ground	20 cm
Diameter of Rotation	2.3 m
Maximum Load	610 kg
Fuel Vonsumption	1 Liter per 25 to 28 km
Front Wheel and Rear Wheel Tire Pressures	2.1 kg/ cm^2 / 2.4 kg/ cm^2
Distance from Ground to Center of Wheel	0.2 m
Vehicle Mass	295 kg
Maximum Speed	68 kg/hr

a) Oil Fuel Mixture of 2%

Table (1) and Fig. (1) Show the variation of velocity against time. Three tests were performed and average values were taken as they are shown in table (1). It has been observed that the average time taken to reach the maximum speed (i.e. 25 kg/hr) for the second gear is 7.01 seconds, and the time taken to reach the speed (40 km/hr) for the third gear is 14.49 seconds, and for the fourth gear the time taken is 84.61 seconds for speed of 58.67 km/hr.

Table 1: Oil - Fuel Mixture of 2%

Variables / Gear Change	Speed (km/ hr)	Time (Seconds)
Second Gear	25	7.01
Third Gear	40	14.49
Fourth Gear	58.67	84.61

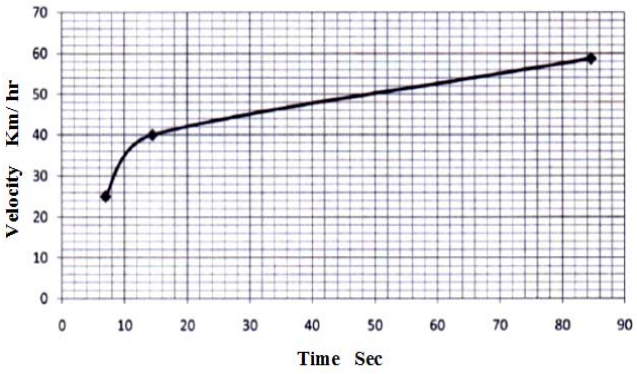

Fig. 1: Velocity against time for oil fuel mixture of 2%

b) Oil Fuel Mixture of 3%

Table (2) and Fig. (2) Show the variation of velocity against time. The average values of velocity and time were taken from three tests. It has been observed that the average time taken to reach the maximum speed (i.e. 25 kg/hr) for the second gear is 7.4 seconds, and the average time to reach the maximum speed (i.e. 40 km/hr) for the third gear is 19.76 seconds, and for the fourth gear the time taken is 88.36 seconds for speed of 60 km/hr.

Table 2: Oil - Fuel Mixture of 3%

Variables / Gear Change	Speed (km/ hr)	Time (Seconds)
Second Gear	25	7.4
Third Gear	40	19.76
Fourth Gear	60	88.36

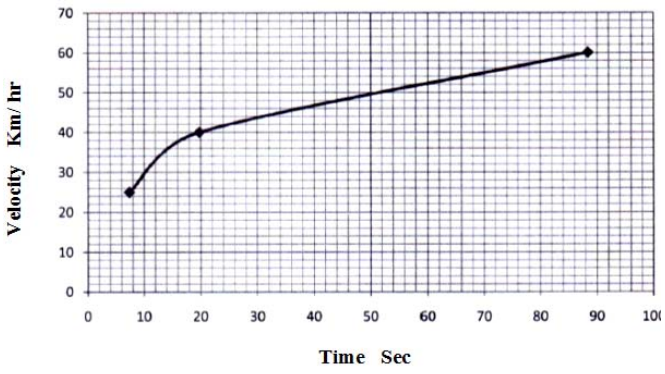

Fig. 2: Velocity against time for oil fuel mixture of 3%

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c) Oil Fuel Mixture of 6.25%

Table (3) and Fig. (3) Show the variation of velocity against time for three consecutive gear changes (i.e. second, third and fourth gears) and their corresponding averaged time taken.

Table 3: Oil - Fuel Mixture of 6.25%

Variables / Gear Change	Speed (km/ hr)	Time (Seconds)
Second Gear	27	7.5
Third Gear	40	16.9
Fourth Gear	60	89.26

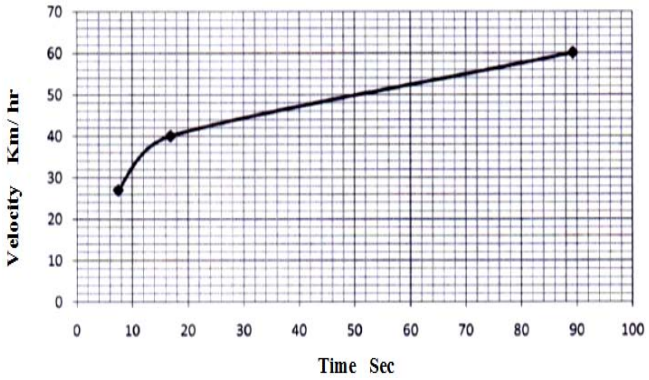

Fig. 3: Velocity against time for oil fuel mixture of 6.25%

d) Oil Fuel Mixture of 10%

Table (4) and Fig. (4) Show the variation of velocity against time for three consecutive gear changes (i.e. second, third and fourth gears) and their corresponding averaged time taken.

Table 4: Oil - Fuel Mixture of 10%

Variables / Gear Change	Speed (km/ hr)	Time (Seconds)
Second Gear	30	7.6
Third Gear	40	19.38
Fourth Gear	58	90.3

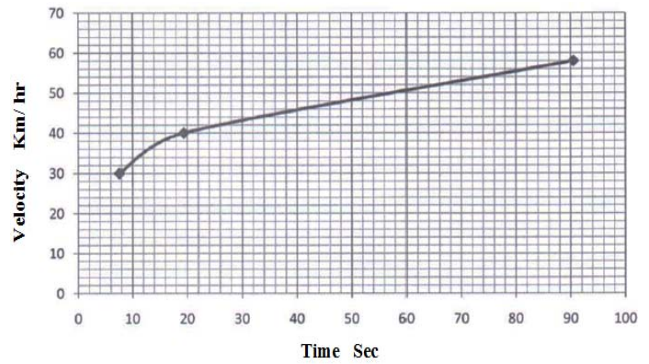

Fig. 4: Velocity against time for oil fuel mixture of 10%

e) Oil Fuel Mixture of 12.5%

Table (5) and Fig. (5) Show the variation of velocity against time for three consecutive gear changes (i.e. second, third and fourth gears) and their corresponding averaged time taken.

Table 5: Oil - Fuel Mixture of 12.5%

Variables / Gear Change	Speed (km/ hr)	Time (Seconds)
Second Gear	28	8.24
Third Gear	40	20.64
Fourth Gear	60	92.3

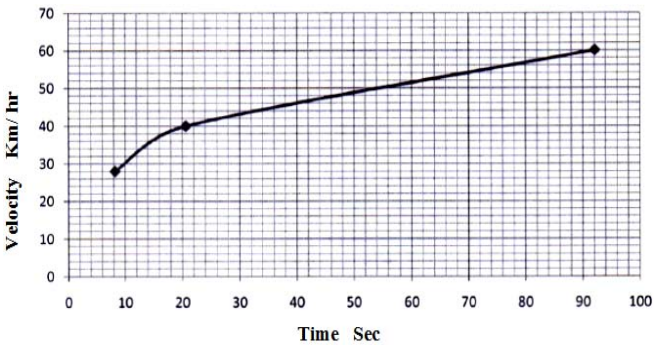

Fig. 5: Velocity against time for oil fuel mixture of 12.5%

VI. Discussion of Results

From the previous tables and diagrams it is observed that the speed is directly proportional to time taken in approximately all the mixtures (i.e. 2%, 3%, 6.25%, 10%, and 12.5%) for all gear changes (i.e. second, third and fourth gear). As an example, when a mixture ratio of 2% is used the time taken to reach maximum velocity at the second gear change which is 25 kg/hr is 7.01 seconds, and when using a mixture ratio of 3% the time taken to reach the same speed is 7.4 seconds, and when using a mixture ratio of 6.25% the time taken to reach the same speed is 7.5 seconds. When a mixture ratio of 10% is used, the time taken to reach the maximum velocity (i.e. 25 kg/hr) is 7.6 seconds and when using oil - fuel mixture of 12.5% the time taken to reach the same maximum speed is 8.4 seconds. This means that as the oil - fuel mixture ratio increases, the time taken to access the maximum speed for every gear change also increases. In other words, the acceleration of the vehicles increases as the oil - fuel mixture ratio decreases.

In Sudan, the rickshaw drivers and mechanics (i.e. maintenance technicians) always use incorrect oil - fuel mixture ratio (i.e. above 5% up to 12.5%) which causes slow acceleration of engine rotation.

The out of proportion of oil - fuel mixture ratio could cause many problems due to different factors which can be summarized as follows:

1) The unburned fuel - oil mixture and small particles of carbon deposits contribute in blocking the ports of passing exhaust gases inside the silencer. This in turn increases pressure and therefore, slows down

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the exit of exhaust gases outside the combustion chamber.

2) The small particles of carbon deposits which form during combustion are accumulated inside the combustion chamber and therefore, minimize its size and consequently cause drop in pressure inside the cylinder. Also, these small and fine particles of carbon deposits may be inserted between the cylinder and piston and subsequently reciprocates with the piston inside the cylinder. This action causes scratches on the surfaces of cylinder and piston and possibly leads to engine overhaul.

VII. Conclusions

From the experiments that were obtained in paragraph 5, it was found that the manufacturers' recommended oil - fuel mixture ratios of 2% in winter season and 3% in summer season are the suitable and optimum ratios that could be used by rickshaw drivers. The advantages of using these ratios could be summarized as follows: (1) longer life of engine, (2) divergence of overhaul maintenance periods, (3) less impact to the surrounding environment.

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References Références Referencias

1. Merriam Webster, "Rickshaw", Retrieved April (2013).
2. Chamberlain, Basil Hall (1891), "Things Japanese: being notes on various subjects connected with Japan for the use of travellers and others", K. Paul, Trench, Trubner and Company Limited; PP. (241-242).
3. Hanchao Lu, "Beyond the neon lights: Everyday Shanghai in the early twentieth century", (1999), University of California Press; PP. (348), ISBN 0520215648.
4. James Francis Warren, "Rickshaw Coolie: A people's history of Singapore (1880 - 1940)", Nus Press; PP. (14), ISBN 997169266X.
5. Chris Carlson, "Critical mass: bicycling's defiant celebration", AK Press; PP. (170), ISBN 1902593596.
6. Stephen Mansfield, D. K. Publishing; (2009), "Eyewitness top 10 travel guide series", Tokyo Penguin; PP. (84), ISBN 0756653673.
7. Louis Fredric, "Japan encyclopedia", Harvard University Press; PP. (424), (2002), ISBN 0674017536.
8. Boye De Mente and Demetra De Ment, "The bizarre and the wondrous from the land of the rising sun", Cultural Insight Books; PP. (94), (2010), ISBN 1456424750.
9. David Diefendorf, "Amazing but false: Hundreds of facts you thought were true, but aren't", Sterling Publishing Company; PP. (223), (2007). ISBN 1402737912.
10. Parker F. Calvin, "Jonathan Goble of Japan", New York: University Press of America, (1990), ISBN 0 - 8191- 7639 - 7.
11. Ed Sobey, "A field guide to automotive technology", Chicago Review Press; (2009, PP. (172), ISBN 1556528124.
12. William E. Lewis, "Through the heartland on U.S. 20: Massachusetts: (17) Volume 1: Ahistorical Travel Guide, Publish America, ISBN 1462624596.
13. "Corson Poley Centre", Burlington County historical society, retrieved, September (2011).
14. Leo Suryadinata, "Chinese adaptation and diversity: Essays on society and literature in Indonesia, Malaysia and Singapore", NUS Press, National University of Singapore, Center for advanced studies, PP. (37), ISBN 9971691868.
15. Pamela Kanwar, "Imperial Simla: the political culture of the Raj, second edition", Oxford University Press; PP. (176), (2003), ISBN 0195667212.
16. Kwang - Joong Kim, "Seoul, Twentieth Century, growth and change of the last 100 years, (2003); PP. (164), ISBN 898052305 X.
17. Ethekwini Municipality Communications Department, edited by Fiona Wayman, Neville Grimmet and Angela Spencer, "Zulu Rickshaws", Durban, South Africa, retrieved, July (2010).
18. Mary Fitzpatric and Kate Armstrong, South Africa: Lesotho and Swaziland, "lonely planet", PP. (308), ISBN 1740599705.
19. A. Adu Boahen, UNESCO, International Scientific Committee for the Drafting of a General History of Africa, " Africa under Colonial Domination (1880-1935), UNESCO; PP. (666), (1985), ISBN 9231017136.
20. Werner Voigt, "60 Years in East Africa: The life of a settler, General Store Publishing House; PP. (32-35), (1995).
21. http://www.ezakwantu.com/Gallery%20Zulu%20Ricksha.hmt.
22. China travel guide, "Tiki travel", FB editions; PP. PT 61, ISBN 9791021306523.
23. Boye De Mente and Demetra De Ment, "The Bizarre and the wondrous from the land of the rising sun", Cultural insight books; PP. (95 - 96), 2010, ISBN 1456424750.

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24. Jay Heale and Zawiah Abdul Latif, "Madagascar" volume 15, culture of the world, Marshall Cavendish; PP. (75 - 76), ISBN 0761430369.
25. Madagascar travel guide, "Lonely Planet", (2013), ISBN 1743213018.
26. Pippa et al., "Frommer's India", (2010) John Wiley and Sons; PP. (15, 57, 156), ISBN 0470645806.
27. Ye etal., "Toxicity and health effects of vehicle emissions in shanghai", Atmospheric Environment, 34 (3); PP. (419 - 429), (2000).
28. Pandey et al., "Health risk of No_2, SPM and So_2 in Delhi (India)", Atmospheric Environment 39; (PP. 6858 - 6871), (2005).
29. Osama Mohammed Elmardi and et al., "Study of the effects of excessive mixture of lubricant oil with gasoline in Bajaj engines (rickshaw)", research thesis, Nile Valley University, Faculty of Engineering and Technology, Atbara, Sudan, (2016).
30. Osama Mohammed Elmardi and et al., “modification of silencer device in rickshaw", research thesis, Nile Valley University, Faculty of Engineering and Technology, Atbara, Sudan, (2016).

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Recycle and Reuse of Textile Waste Liquor from Scouring and Bleaching of Cotton

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Abstract- Environmental pollution is the global issue that results in adverse effects on living beings. It is one of the major concern areas for the whole world. During preparation of cotton woven fabric before dyeing mainly involves desizing, scouring and bleaching. Each process drains a plethora of chemicals along with water, in the effluent stream. The released chemicals by the global textile industry are continuously doing unimaginable harm to the environment. The focus of this research is to investigate the opportunities to prevent the pollution by recycling and reusing, the water and chemicals without addition of any treatment.

Keywords: *scouring, recycled, pretreatment.*

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Recycle and Reuse of Textile Waste Liquor from Scouring and Bleaching of Cotton

Zinia Yasmin [α], Md. Moynul Hassan Shibly [σ], Md. Sazol Ahmmed [ρ] & Sushama Saha Swati [ω]

Abstract- Environmental pollution is the global issue that results in adverse effects on living beings. It is one of the major concern areas for the whole world. During preparation of cotton woven fabric before dyeing mainly involves desizing, scouring and bleaching. Each process drains a plethora of chemicals along with water, in the effluent stream. The released chemicals by the global textile industry are continuously doing unimaginable harm to the environment. The focus of this research is to investigate the opportunities topreventthe pollutionby recycling and reusing, the water and chemicals without addition of any treatment.

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I. Introduction

Industrialization has brought ease, comfort, luxury, and prosperity to our modern life. Wet processing industry uses vast amounts of water, energy, and chemicals. At the same time, it has also created problems for us. Two issues of concern today are environmental pollution by the industrial waste generated during manufacturing activities, and the other is the endangerment of the health and safety of the user of the industrial products. There are two approaches, to combat the menace of environmental pollution by liquid waste from the dye house/print works. One is the operation of Effluent Treatment Plant to control the pollution and the other is to prevent the pollution. The U.S. Environmental Protection Agency defines pollution prevention (also referred to as source reduction) as the use of materials, processes, or practices that reduce or eliminates the generation of pollutants or wastes at the source. Pollution prevention minimizes water pollution, land, and air. It is a source reduction and other practices that reduce or eliminate the creation of pollutants through increased efficiency in the use of raw material, energy, water or other natural sources or protecting resources through conservation. Reducing the volume of effluent released through the prevention of pollution can be accomplished by conservation and more efficient use of resources. Pollution prevention is accomplished through many ways such as:

- Good housekeeping and maintenance.
- Substitution of chemicals.
- Process modification and technology through the selection of clean/green technology.
- Recycle, Reuse and Recovery.
- Modification of machinery, equipment optimization of processes, dyes, chemicals, and water [8].

Moreover, Pollution prevention is more than just another way of reducing pollution. Pollution prevention is a philosophy. Such a philosophy does not accept "that is how we always did it" as a rationale for maintaining a policy or practice [3].

Pollution prevention may result in several benefits for the textile processor, these includes:

- Loss Reduction.
- Decreased Waste Collection.
- Decreased Handling and Disposal Cost.
- Reduction of Chemical, Water and Energy Consumption, thereby resulting in savings, sometimes even increased production.
- Improve Compliance with Regulations.
- Improve Employee morale and Participation.

Textile pre-treatment involves desizing, scouring and bleaching process. Desizing is a process of removal of starch from the woven fabric. Scouring removes the natural (oil, wax, gum, fat etc) impurities. Bleaching destructs the natural color from the textile material. Each process drains a plethora of chemicals along with water, in the effluent stream. Pollutants released by the global textile industry are continuously doing unimaginable harm to the environment. It pollutes land and makes them useless and barren in the long run [2, 3]. Table 1.1 - Water usage and pollution loads in cotton pretreatment processes [7]

Pre-treatment Process	Water Usage (l/kg)	Water Usage (%)	Approx BOD (mg/l)	BOD (%)	Pollution Load (%)
Desizing	20	5	4500	22	>50
Scouring	4	1	11000	54	10-25
Bleaching	180	46	1000	5	3

The main work of this research is to recycle and reuse the water and chemicals of the textile pre-treatment process. Recycle means utilization of previously used process liquor one or more times/ purpose whereas reuse can be defined as the utilization of used process liquor for another purpose.

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II. Literature Review

a) Cotton

Cotton is nature's most abundant polymer. It is an organic cellulosic compound which is a kind of polysaccharide. Cotton is the backbone of the world's textile trade. In the world cotton fiber has many qualities and countless end uses. Cotton mill consumption estimated around 24.3 million tones which are 45% of total world fiber productionin 2015 [1]. It is a soft fiber of genus *Gossypium*. The cotton plant belongs to the natural order of the MALVACEAE. The cellulose polymers in cotton fiber have high degree of polymerization. The DP (Degree of polymerization) of cellulose molecule is high. It ranges as 10000 [1, 2].

b) Fibre Morphology

Cotton is the important fiber in today's textile industry. The major use of cottonis to make the garments for over 5000 years before, so knowledge of the structural features of these cellulose substrates is essential for analyzing the effects of physical and chemical properties. Cotton fibers have a fibrillar structure. Their morphology, illustrated schematically in below figure, exhibits four main features: cuticle, primary wall, secondary wall, and lumen.

Cotton consists of cellulosic and non-cellulosic material; the primary wall has a network of cellulose fibrils covered with the outer most layer cuticle, covered waxes, and proteins. It serves as a smooth, water-resistant coating, which protects the fiber. The outer cell wall is relatively hydrophobic.

The wax renders the fiber impermeable to water and aqueous solutions unless a wetting agent is present. Cuticle layer surrounded by a primary wall, built of cellulose, pectin, waxes and protein material. The inner part of the cotton fiber comprises of the secondary part, subdivided into several layers of parallel cellulose fibrils and the lumen. The secondary wall consists of several layers and the spiral angle of the fibrils varies from one layer to the next, from about 20° to 35°. The lumen, the cavity that may remain after the protoplasm in the cell interior has proteins, coloring matter and minerals deposited on its walls. The smallest unit of the fibrils consists of densely packed bundles of cellulose chains [6, 9].

The hydroxyl groups OH^-protruding from the sides of the molecule chain link neighboring chains together by the hydrogen bond and form ribbon-like micro-fibrils which arranges into larger building blocks of the fiber [2].

It is very laborious to give a precise value for the degree of polymerization (n) of cotton. The DP of cellulose varies with itsorigin and is expressed as an average value, since a distribution found in most samples. The degree of polymerization of cellulose molecule may be as high as 10000 [4].

III. Methodology

a) Process Flow Chart

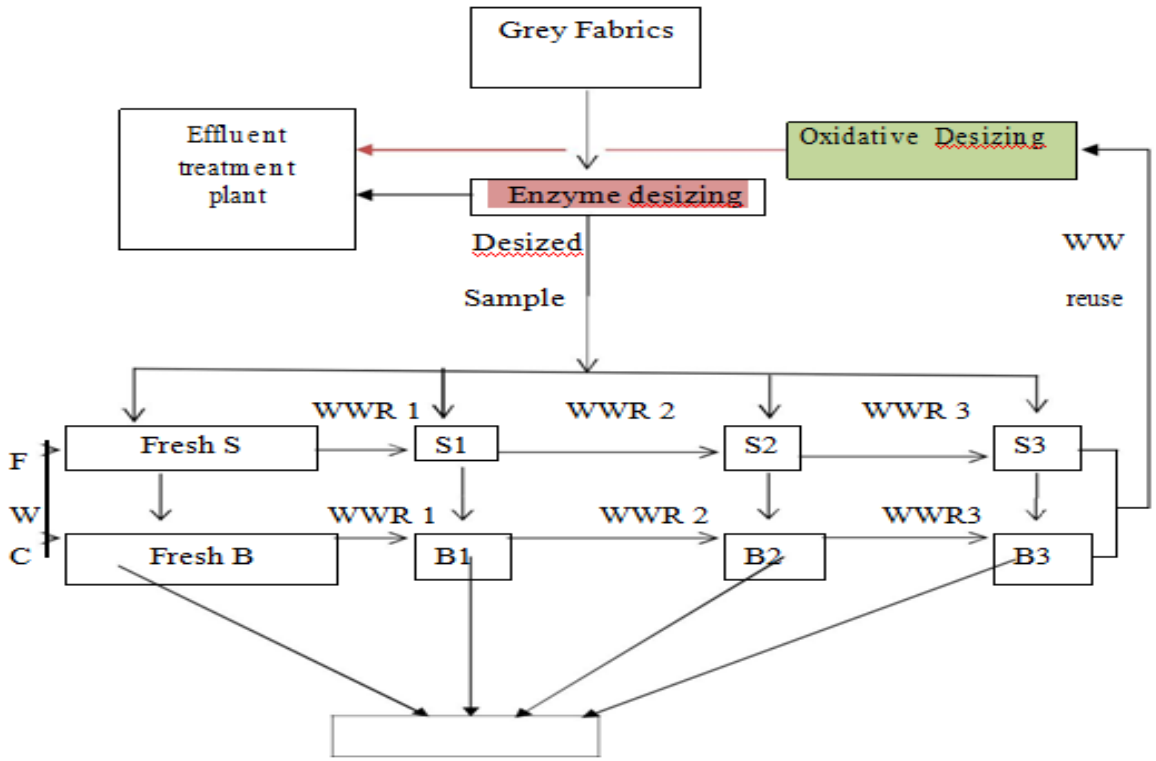

Fig. 3.1: Schematic Flow Diagram of the Recycle and Reuse Process

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b) *Process Curve for Desizing*

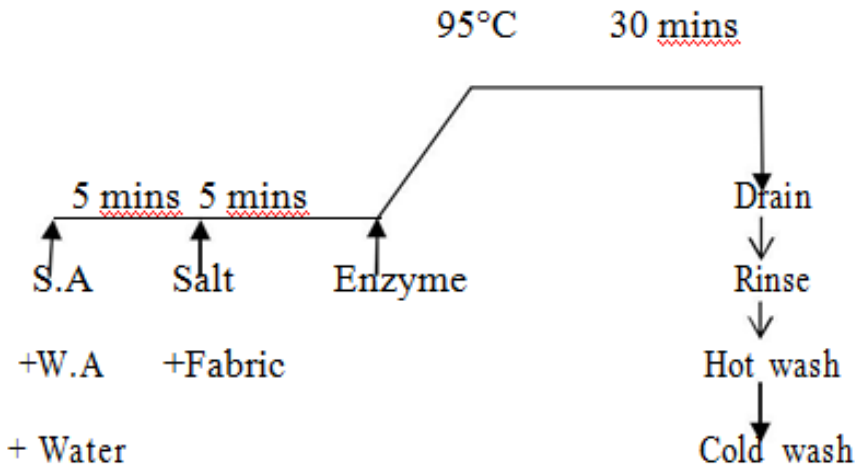

Fig. 3.2: Process for Curve Desizing

c) *Process Curve for Scouring*

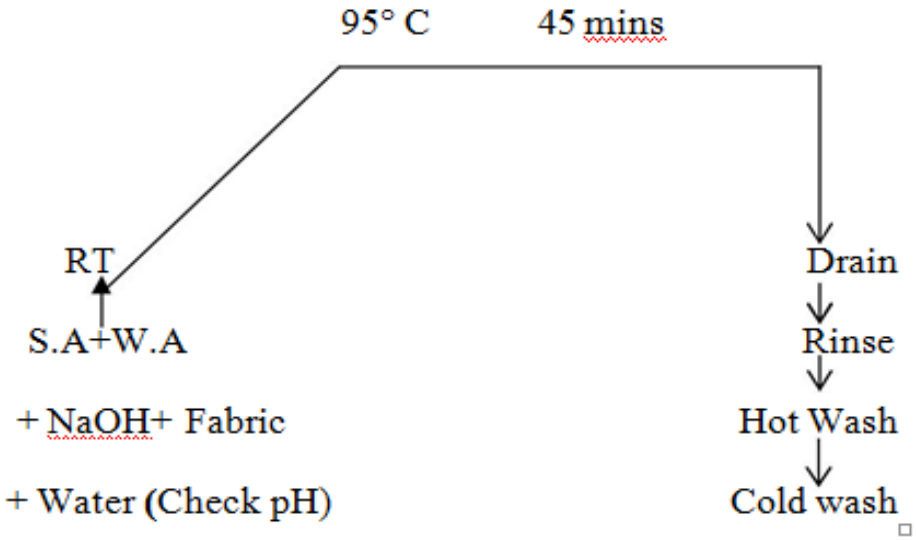

Fig. 3.3: Process Curve of Scouring

d) *Process Curve for Bleaching*

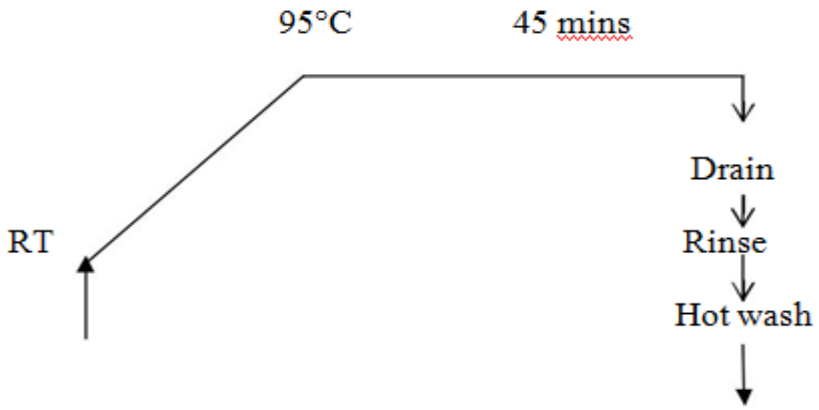

Fig. 3.4: Process Curve of Bleaching

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IV. Testing & Analysis

a) Tegewa Test

Iodine drop test (Tegewa test) employed to check the desizing efficiency. The principle of this testis the violet coloration of starch with iodine. Hence, the presence of starch remaining on fabric deciphered. The desized fabric immersed in a beaker consists of a solution of potassium iodide and iodine for 1 min. After one minute the sample rinsed thoroughly under water, dabbed with filter paper and compared with the Tegewa scale or violet scale, having rating 1 to 9. The scale denotes 1 is no removal of size material and rating of 9 indicate complete removal of size material from the fabric. The acceptable rating is 6-7.

b) Drop Test

The absorbency test followed by using AATCC Test Method 79-2000, where a drop of water is acquiesced to fall from a settled height onto the firm surface of a sample specimen. The time required for the reflection of the water drop to disappear, measured and recorded as wetting time. It took five seconds or less to represent the adequate absorbency.

c) Column Height

For column height, 18X5 cm^2 sample was prepared. This sample hung from support by immersing the 1 cm portion of the fabric.

The sample was dried and observed the wicking height performance. The wicking length is 30-50 mm and the above range indicates excellent scouring. 30 mm denotes acceptable and 40-45 mm is good to very good scouring.

d) Presence of Alkali in the Scouring Bath

In this test, the accurately measured volume of the sample titrated against a standard sulphuric acid solution with a phenolphthalein indicator. The alkalinity measured is regarding of $CaCO_3$ (mg/l)

Where,

Alkalinity, mg $CaCO_3$/ l = (A)(N)(50,000)/ml sample:

A: Milliliter of the standard acid used,

N: Normality of the standard acid.

e) Presence of alkali in the bleach bath containing peroxide

This test carried as per AATCC Test Method 98-2007. A weighed specimen of the bleach bath is titrated with a standardized solution of sulphuric acid using Phenol Red indicator or to the pH range 6.8–8.4 on a pH meter. The total alkali expressed as % NaOH, is calculated based on the weight of the bath.

% Total alkali, as NaOH.

% = (ml)(N)(0.040)(100)/W Where,

ml: The number of milliliters of the sulphuric acid solution required,

N: The normality of the sulphuric acid solution,

0.040: The milliliters equivalent weight of sodium hydroxide,

W: Mass of the specimen.

V. Result

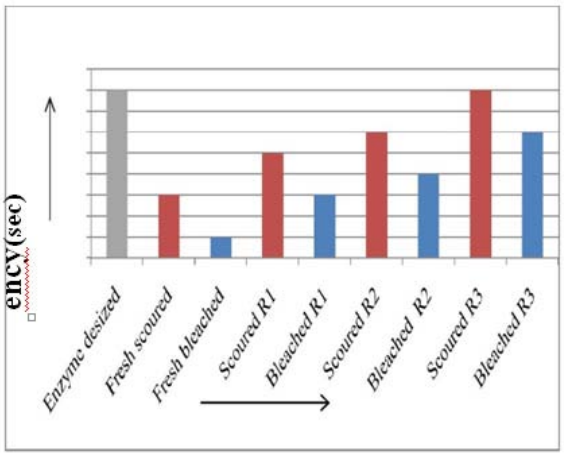

Fig. 5.1: Absorbency Test Result

From fig 5.2 it was seen that the 1st and 2nd recycle scoured sample gave better result compared to 3rd sample which was in acceptable range (above 30mm). Column height gradually falls due to decrease of alkali content in the recycled bath.

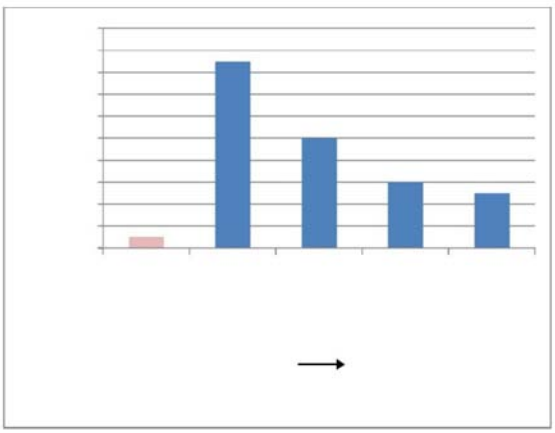

Fig. 5.2: Column Height of Different Scoured Samples

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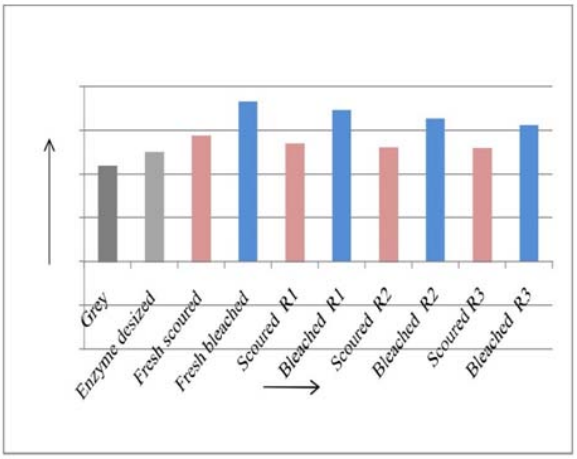

Fig. 5.3: Weight Loss Percentage of Different Processed Sample

From fig 5.3 it was found that weight loss% were lower in every step of scouring processing with recycled liquors. The reduction in weight loss indicates the reduction of alkali in recycling bath. As the more recycled, less scouring action occurs so the 3rd recycling bath shows minimum weight loss.

In case of bleaching also similar trend was observed in respect of weight loss. The loss in peroxide strength resulted in the decrease in weight loss.

VI. Conclusion

The proposed sustainable pre-treatment process was highly efficient in conserving water, energy and process chemicals. When the scouring and bleaching baths recycled, excess utilization of alkali and hydrogen peroxide in both process seen. The fabric properties after recycling was found good up to 2 times. Samples treated in the mixed bath, also showed good scouring and bleaching effect among them, the bath ratio was S:B 30:70 provided a better result. By understanding the potential of the waste stream, it can generate a new way to reduce discharged wastage water and chemicals. This work will reduce the effluent and minimize the load on the effluent treatment plant.

References Références Referencias

1. Eichhorn, S., et al., Handbook of Textile Fibre Structure: Natural, regenerated, inorganic and specialist fibres. Vol. 2, 2009.
2. Needles HL, Textile Fibers, Dyes, Finishes, and Processes: A Concise Guide: Noyes Publications; 1986.
3. Cook, J.G., Handbook of Textile Fibres: Natural Fibres, Merrow Publishing Company, 1968.
4. Morton WE, Hearle JWS, Institute T. Physical Properties of Textile Fibres: Woodhead Publishing; 2008.
5. Karmakar SR. Chemical Technology in the Pre-Treatment Processes of Textiles: Elsevier Science; 1999.
6. Choudhury AKR. Textile Preparation and Dyeing: Science Publishers; 2006.
7. Broadbent AD, Dyers So, Colourists. Basic Principles of Textile Coloration: Society of Dyers and Colourists; 2001.
8. J. Shore (Ed.),Cellulosics Dyeing, Bradford, UK: SDC, 1995.
9. J. Park and J. Shore, J. Soc., Water for the dyehouse: supply, consumption, recovery and disposal, Dyers Col., 1984.
10. G.N. Mock., Bleaching, In: Enclyclopedia of Polymer Science and Engg, Vol. 2, 2nd Edn New York, USA: John Wiley, 1985, 310-323.
11. W.N. Marmer, J.M. Cardamone, B.G. Ping, and F. Casado, Text. Chem. Colorist, 1993.
12. Rahman Bhuiyan, M. A., Mizanur Rahman, M., Shaid, A., Bashar, M. M., & Khan, M. A. (2016). Scope of reusing and recycling the textile wastewater after treatment with gamma radiation. Journal of Cleaner Production, 112(4), 3063– 3071.
13. Chakraborty JN, Chakraborty JN. Fundamentals and Practices in Colouration of Textiles, Second Edition: WPI India; 2014.
14. Renfrew AHM, Hunter A, Dyers So, Colourists. Reactive Dyes for Textile Fibres: The Chemistry of Activated [pi]-bonds as Reactive Groups and Miscellaneous Topics: Society of Dyers and Colourists; 1999.
15. P.B. Jhala, M.M. Vyas and K. Subrahmanyam. 1981, Water and Effluents in Textile.
16. R. E. Yelin and Villiers, Textile Chem. Color., 4 (1972) 50.
17. G.N. Mock. 1985, Bleaching, In: Enclyclopedia of Polymer Science and Engg, Vol. 2, 2nd Edn (New York, USA: John Wiley) 310-323.Mills (Ahmedabad, India: ATIRA).
18. Bergenthal, J.F., Wastewater Recycle and Reuse Potential for Indirect Discharge Textile Finishing Mills. 1984: US Environmental Protection Agency, Industrial Environmental Research Laboratory.
19. International Journal of Engineering Research and Development e-ISSN: 2278-067X, ISSN: 2278-800X Volume 5, Issue 8 (January 2013), P. 45-54.
20. Shaid, A., Osman, S., Hannan, A., &Bhuiyan, M. A. R. ,Direct reusing of textile wastewater in scouring-bleaching of cotton goods devoid of any treatment. International Journal of Engineering Research and Development, 5, 45–54, 2011.

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Understanding Apparel Preference of Different Social Status People of Bangladesh Apparel Market

By Md. Moynul Hassan Shibly, Zinia Yasmin, Md. Sazol Ahmmed & Sushama Saha Swati

Primeasia University

Abstract- The information about apparel preferences by various social status people of Bangladesh is represented in this paper to get a clear scenario to understand customer demand in Bangladesh local market. The Apparel Industry reflects people's lifestyles and shows their social and economic status. Therefore, different social status people of Bangladesh apparel preferences are essential to research because it is a vital sector of consumer behavior. The key objectives of the study are to assume apparel preferences in different status people of Bangladesh apparel market. Then a questionnaire was prepared to collect primary data from various social status people of Bangladesh Dhaka city areas, people's Yearly income, Gender, Name, Occupation, Age, Product Name, Favorite Brand, Color, Cost, Design & Buying place of apparel. The collected data were then represented by using different quantitative tools. Apparel companies can target the right target segment regarding gender, age group, income, personality, culture, etc. By observing the apparel preferences of different customer it will be very easy task for vendors to launch the products in the market as per customer choice and demand.

Keywords: *marketing, survey, brand.*

GJRE-J Classification: *FOR Code: 091599*

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Abstract- The information about apparel preferences by various social status people of Bangladesh is represented in this paper to get a clear scenario to understand customer demand in Bangladesh local market. The Apparel Industry reflects people's lifestyles and shows their social and economic status. Therefore, different social status people of Bangladesh apparel preferences are essential to research because it is a vital sector of consumer behavior. The key objectives of the study is to assume apparel preferences in different status people of Bangladesh apparel market. Then a questionnaire was prepared to collect primary data from various social status people of Bangladesh Dhaka city areas, people's Yearly income, Gender, Name, Occupation, Age, Product Name, Favorite Brand, Color, Cost, Design & Buying place of apparel. The collected data were then represented by using different quantitative tools. Apparel companies can target the right target segment regarding gender, age group, income, personality, culture, etc. By observing the apparel preferences of different customerit will be very easy task for vendors to launch the products in the market as per customer choice and demand.

Keywords: marketing, survey, brand.

I. Introduction

The apparel industry is widely effected by the ever-changing consumer demanded preference both in local and foreign market worldwide. Marketing needs to understand the behavior of customer so as to cater the challenges of diversity. As Bangladesh doing its RMG products business both in the international and the local market with praising fame and faith, so many local apparel brands are growing their business like a newly born baby. It is difficult task for various local brand to meet customer needs as world fashion is changing day by day. Ask to understand hence, an approach was made in this study to investigate the customer's perception in buying decisions toward local apparel products. The work also reported that customer desires the products quality, comfort, price, functional and aesthetic look, offer & discount and many others key buying factors suitable for them when visiting a brand showroom. Menswear industry is changed day by day according to the change of men's lifestyles. The objectives of the study was to get better information about male's customer satisfaction while buying their own apparel products. Most of the male customer were happy with the updated fashionable products available in local market. Design, style, cost are the main attributes for male customer while buying apparel products for themselves. The Apparel Industry reflects people's lifestyles and shows their social and economic status. Therefore, different social status people of Bangladesh apparel preferences are important to research because it is an important sector of consumer behavior. Both knit and woven items are imported from Bangladesh towards various country worldwide. As Bangladesh has a great reputation in Ready Made Garments (RMG) sector so the quality of the products must be good as per buyer requirement. On the other hand, Bangladeshi manufacturers have to ensure better working environment for workers and quality products to meet the world challenge in apparel market.

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II. Literature Review

Customer behavior is very essential issue in world apparel market as customer plays a vital role. As world fashion is changing dramatically consumer behavior is difficult to predict. [1]

A "trend" occurs when a new design in accepted and sells in sufficient quantity in some test markets, and then creates a demand from consumers across a broader market. [2]

The fashion cycle, or fashion life cycle, comprise the introduction, acceptance, culmination, and decline of a certain style. [3]

According to the relative length of acceptance cycle, there are other three kinds of "fashion" besides moderate fashion, which can be named fads, fast fashion and fast fashion and classics. [4]

The parametric feature-based modeling enables the automatic generation in fitted garments on differing body shapes. Consumer lean towards buying such apparel that are largely sold as designer apparel. [5]

The institutional capacity of the Government to conduct the regular labour inspection of factories across Bangladesh must be greatly strengthened. The ILO negotiated agreement calls for 200 labour and factory inspectors to be appointed by the end of 2013 and the recruitment of another 800 inspectors in 2014. [6]

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Bangladesh must first itself ratify the ILO Convention on Decent Work for Domestic Work. Only with ratification at home, can Bangladesh fully engage with destination countries and encourage them to ratify the Convention and thereby ensure the safety and security of workers while abroad.[7]

III. Methodology

The key objectives of the study is to predict apparel preferences in different status people of Bangladesh apparel market. Then a questionnaire was prepared to collect primary data from various social status people of Bangladesh including Dhaka city areas, their yearly income, name, occupation, age, product name, favorite brand, color, cost, and design & buying a place of apparel. The collected data were then represented by using different quantitative tools. The survey is divided into two groups for performing our work efficiently & collected essential information from a different place. The Data was collected from Uttara, Gulshan, Banani, New market, Elephant Road, Mohakhali, Dhanmondi, Kajipara, etc.

IV. Data Analysis

Before Buying a Garments which requirement do you prefer first

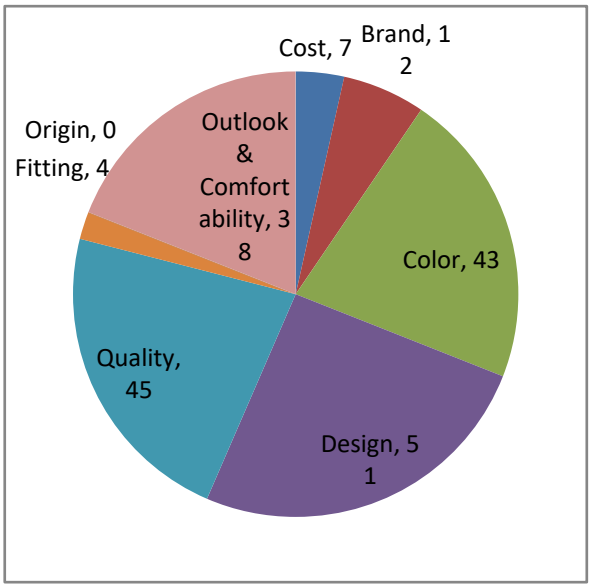

Fig. 1: Different Criteria in Apparel Choosing.

By observing this graph, we can see that the first position is design, the second position quality, third position is color & last state is the origin.

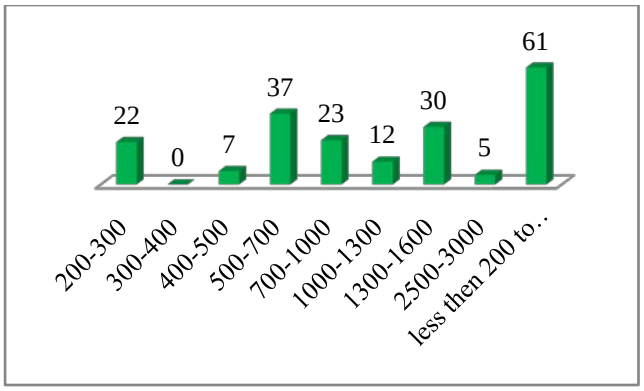

Fig. 2: Cost of Product in Apparel Choosing.

From this graph, we can see that 37 people out of 200 buy their garments at Tk 500-700. People prefer to 1300-1600 is 15%, 22 people buy a product at range to 200-300.12.5% people buy at range to 700-1000. Only five people like to buy there product at tk 2500-3000. 61 people prefer to buy less then taka 200 & above taka 3000.

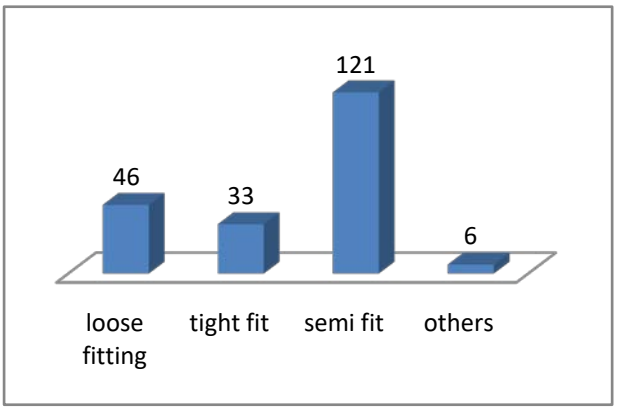

Fig. 3: Different Types of Fitting

By observing this graph, we can see that the first choice is semi-fit. The second choice loose fitting, third choice is tight fit & a few people like another type of attachment.

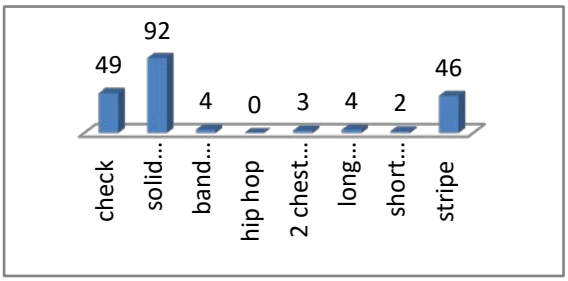

Fig. 4: Different Types of Design.

In this graph, we see that most of the people like solid color, secondly they like check, then stripe, brand, color, long length, two chest pocket, short length & nobody like hip hop style.

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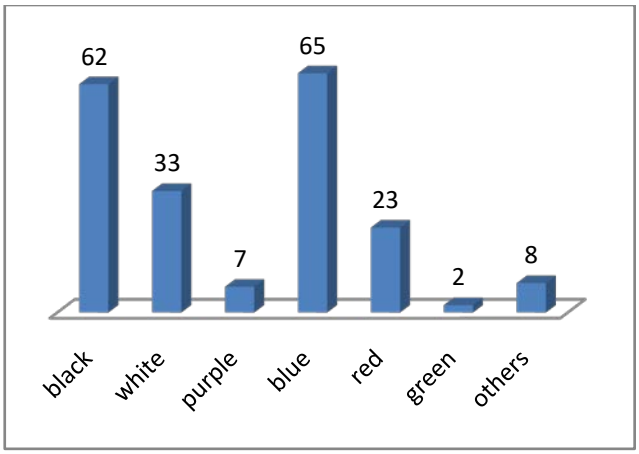

Fig. 5: Different Color of Garments

Here it is clearly seen from this graph, the first choice is the blue color, the second choice is black color, then white, red, purple, green &many people like different color.

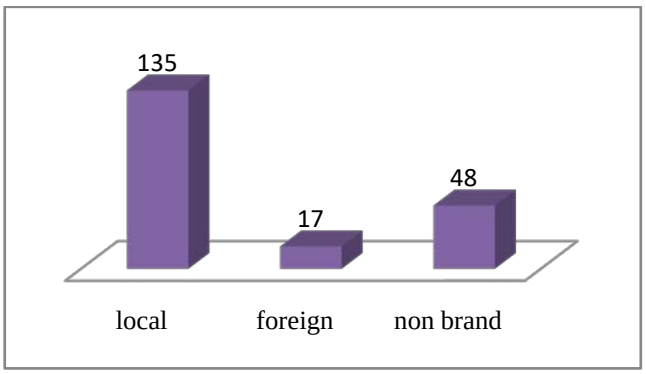

Fig. 6: Choice of Brand

By observing this graph, we can see that the most people choose the local brand, the second choice is non-brand & a little people choose foreign brand.

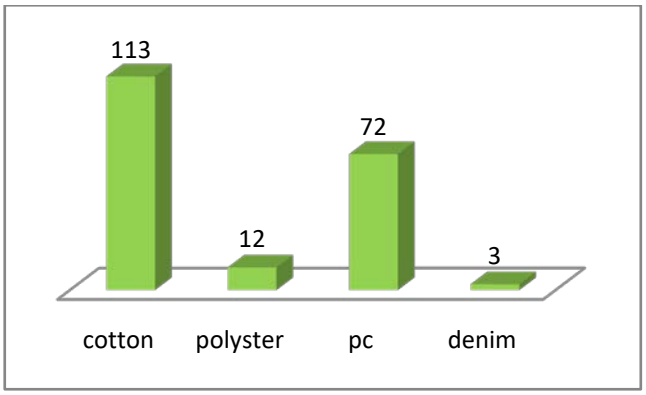

Fig. 7: Choice of Fabric.

In this graph we see that most of the people like cotton fabric & it is 113 persons, secondly, they like polyester-cotton & it is 72 people, then polyester fabric 12 people, & last they choose denim it is three people nowadays.

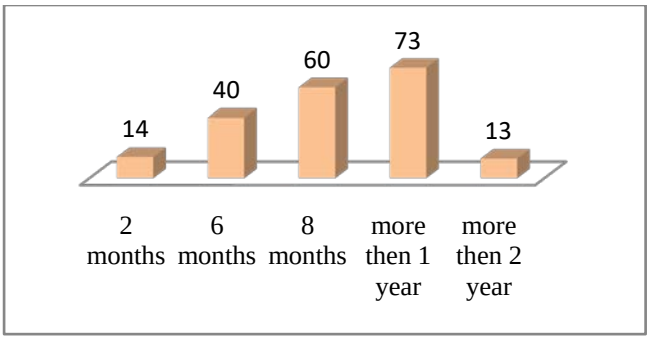

Fig. 8: Duration of Serviceability

This graph shows that most people need more than one-year serviceability. Secondly they want eight months, thirdly six months, then two months, &more than two years.

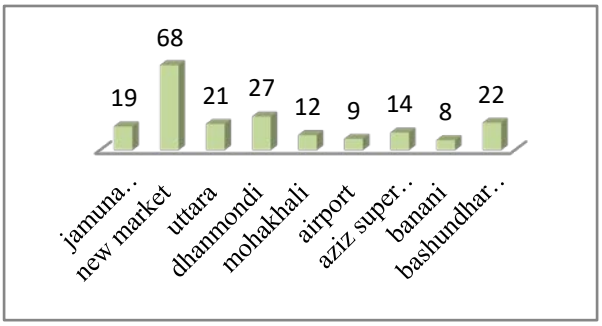

Fig. 9: Different Buying Places.

This graph shows that a large number of people buy their garments new market & it is 68 people, second they buy Dhanmondi, Bashundhara City, Jamuna Future Park, Uttara, Banani, Aziz Super Market & Airport.

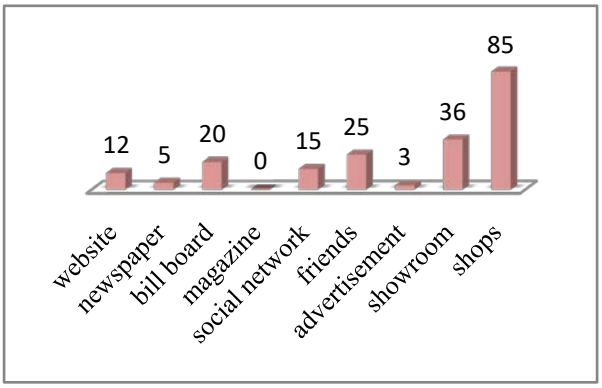

Fig.10: Source of Buying.

People of different level know the buying source from shops, showroom, friends, social network, magazine etc.

People buy the product by knowing about this product from shops mostly, they also get information from showroom, third, fourth, fifth, sixth, seventh, eighth, & last know from friends, bill board, social network, web sites, newspaper, advertisement & magazine respectively.

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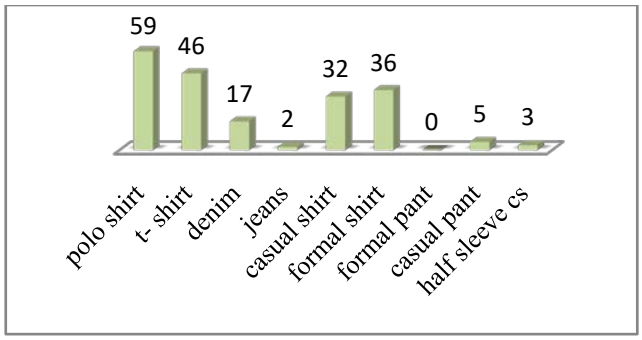

Fig. 11: Choice of Different Garments.

From this graph we can see that people's first choice is polo shirt, second choice is t- shirt & it is 46 out of 200, the third choice is formal shirt & it is 36 out of 200, fourth, fifth, sixth, seventh, eighth, ninth is casual shirt, denim, casual pant, half sleeve casual shirt, jeans &formal pant respectively.

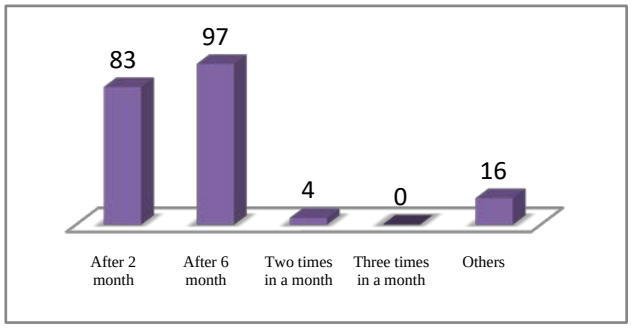

Fig. 12: Buying Frequency.

From this graph, we can see that most of the people buy garments after six months, & it is 97 out of 200. Then 83 people buy after 2 months. Only four people out of 200 purchase their garments two times in a month. No people buy three times in a month & other 16 people buy different times.

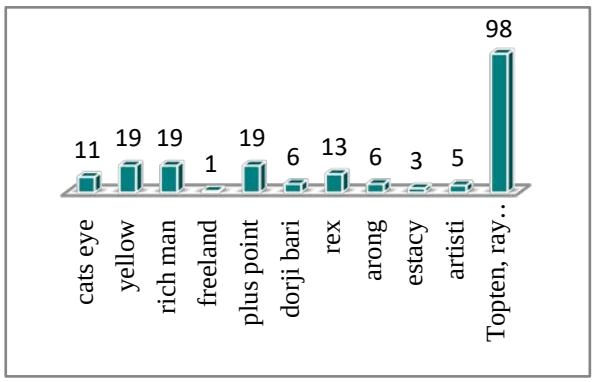

Fig. 13: Different Local Brand.

From this graph we see people buy their garments from multi brands which are not mentioned here. But Yellow, rich man & plus point is the top chart brand nowadays. Cats Eye, Rex, Arong & Dorjibari is the second choice of people. People buy garments from others brand like Freeland, Ecstacy, Artisty, etc.

V. Result

In Bangladesh apparel market various social status people prefer Design & Quality mostly before purchasing an apparel as per our observation by doing this survey among different social status people. Though product origin is valuable criteria; it is less preferable during buying products, and as for fabrication cotton is preferable to people while buying products from the local brand, from new market shops.

VI. Conclusion

The demand for Bangladesh apparel market to local people & foreign buyer is increasing day by day. As a result, lots of local & foreign brand is established as to fulfill the needs of various social status people and before buying a product from Bangladesh apparel market customer can set their preference as like as design, quality, price, etc. to get a better product for using.

References Références Referencias

1. Margaret K. Hogg Margaret Bruce, Alexander J. Hill, (1998) "Fashion brand preferences among young consumers", International Journal of Retail & Distribution Management, Vol. 26 Iss: 8, pp. 293-300.
2. Tajuddin, Rosita Mohd; Tan, Hui Siang; and Karpova, Elena E., "Understanding Apparel Preferences in the Multi-Ethnic Malaysian Market" (2010). *Apparel, Events and Hospitality Management Conference Proceedings and Presentations.* Paper 42.
3. Arora, R. (2006), "Product positioning based on search, experience and credence attributes using conjoint analysis", Journal of Product & Brand Management, Vol. 15, No. 5, pp. 285-92.
4. Shubhasish, B.; Majumder, M. A.; Akhtaruzzaman, M. 2007. Determinants of workers' remittances in Bangladesh: an empirical study (Dhaka: Policy Analysis Unit Bangladesh Bank).
5. Siddiqui, T. 2005. International labour migration from Bangladesh: A decent work perspective, Policy Integration Department Working Paper No. 66 (Geneva: ILO). Available at: http://archive.unctad.org/sections/wcmu/docs/ciem4_Country_Paper_Philippines_De_Vries_en.pdf [25 May].
6. Hussain, Z.; Naeem, F. 2009. Remittances in Bangladesh: Determinants and 2010 outlook. Available at: http://blogs.worldbank.org/endpovertyinsouthasia/remittances-bangladesh-determinants-and-2010-outlook-0 [25 May 2013].
7. Ghosh, B. 2006. Migrants' remittances and development: Myths, rhetoric and realities (Geneva, International Organization for Migration (IOM).

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Supplier Selection using Integer Linear Programming Model

By Sourav Kumar Ghosh, Naurin Zoha, Tanzima Zoha Chowdhury & Md. Sazol Ahmmed

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Abstract- Contemporary business organizations highly depend on outsourcing for success in today's competitive marketplace and selecting a suitable supplier is essential for developing new products. To ensure effective upstream management, supplier selection plays a key role in supply chain management. Nowadays to keep pace with the global competition, organizations tend to build a long-term relationship with the vendors. As a result, the direct and the indirect consequences of poor decision-making become more severe. There are a lot of methods to determine the best matched supplier for a particular product. In this study, at first, we have calculated the weighted values through MCDM process (Using AHP) for the different product for different vendors. Then we have proposed a vendor selection model using Integer Linear Programming (ILP) Model for multiproduct, multi-vendor environment. The research is intended to build up a generic model to be utilized in different scenarios in the decision making process according to the company's own preference. We check the validity of the model with a case study for managing the best suppliers for knit fabrics of a renowned textile industry of Bangladesh.

Keywords: vendor selection, upstream management, ILP, AHPM. MCDM.

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Supplier Selection using Integer Linear Programming Model

Sourav Kumar Ghosh [α], Naurin Zoha [σ], Tanzima Zoha Chowdhury [ρ] & Md. Sazol Ahmmed [ω]

Abstract- **Contemporary business organizations highly depend on outsourcing for success in today's competitive marketplace and selecting a suitable supplier is essential for developing new products. To ensure effective upstream management, supplier selection plays a key role in supply chain management. Nowadays to keep pace with the global competition, organizations tend to build a long-term relationship with the vendors. As a result, the direct and the indirect consequences of poor decision-making become more severe. There are a lot of methods to determine the best-matched supplier for a particular product. In this study, at first, we have calculated the weighted values through MCDM process (Using AHP) for the different product for different vendors. Then we have proposed a vendor selection model using Integer Linear Programming (ILP) Model for multi-product, multi-vendor environment. The research is intended to build up a generic model to be utilized in different scenarios in the decision making process according to the company's own preference. We check the validity of the model with a case study for managing the best suppliers for knit fabrics of a renowned textile industry of Bangladesh.**

Keywords: vendor selection, upstream management, ILP, AHPM. MCDM.

I. Introduction

The supplier selection is a very crucial problem in today's highly dynamic business scenario involving many qualitative and quantitative criteria. Suppliers are considered as a key to a firm's ability to provide quality products in shorter time at lower costs and with greater flexibility and reduced risk [1]. The rise in outsourcing and off shoring practices due to globalization has also added to complexity of supplier selection problem. Moreover, the need to develop sustainable supply chain practices in organizations [2] [3] have made supplier selection problem even more challenging. Hence, in order to choose best suppliers, it is important to achieve a tradeoff between these criteria which may be conflicting in nature. Hence supplier selection is a multi-criteria decision making (MCDM) problem. We develop an integer linear programming (ILP) model for this purpose. Linear Programming (LP) is one the most widely used techniques in the world of optimization, where a particular objective function is developed for some unknown variables to be either maximized or minimized considering limitations or constraints. ILP is one of the LP techniques where the unknown variables are all bound to be integer numbers. There is another type of LP called the Binary Integer Programming (BIP), where the unknown variables can only be 0 or 1. This is, in fact, a special case of ILP. This special form gives the model a little more dimension in the process of decision making. The numbers in this case represent the selection choices instead of their arbitrary values. For instance, in our vendor selection method, the value for the corresponding unknown variable of a vendor signifies if the vendor is selected or not for supplying that particular product. The value 1 represents the selection of that vendor and the value 0 represents that the vendor is not selected. The model is developed to fit the preference of the company depending on their requirements and preference. In different circumstances, different vendors may be selected. There are multiple criteria that determine the optimized selection of the vendor. We develop this model keeping in consideration the weights of all the criteria and selecting the most optimal vendor to maximize profits and reduce risk in the overall purchasing process.

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II. Literature Review

There are a number of MCDM techniques applied in supplier selection process such as analytic hierarchy process (AHP) [4], analytic network process (ANP) [5], technique for order preference by similarity to ideal solution (TOPSIS) [6], Fuzzy set theory, elimination and choice expressing reality (ELECTRE), Preference ranking organization method for enrichment evaluation (PROMETHEE), data envelopment analysis (DEA), mathematical programming and their hybrids to supplier selection. There are plenty of supplier selection methods available in the literature. Linear Programming (LP) formulates the supplier selection problem in terms of a mathematical objective function which is a linear function that needs to be maximized (e.g., maximize profit, Productivity) or minimized (e.g., minimize costs, lead time). LP has some resource constraints which need to be satisfied. Some of the mathematical programming models [7] focus on the modeling of specific discounting environments. Akinc [8] concentrates on decision support regarding the number of vendors. Current and Weber use facility location model constructs for the vendor selection problem. Das

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function is to minimize the total cost of the wholesaling service by optimizing the selection of the manufacturer. Weber et al. [10] combine MP and the DEA method to negotiate with the vendors that are rejected to ensure the number of vendors to use. [11] Karpak et al. [12] use goal programming to minimize costs and maximize quality and delivery reliability when selecting vendors and allocating orders between them. Manoj Kumar et al. [13] develop a decision tool using multi-objective integer linear progr

III. Methodology

a) Assumptions

i. We didn't consider peak and off seasons for the process.
ii. We didn't account resource constraints or other constraints.
iii. We neglected some criteria for simplification of the case.
We considered only one decision maker.

b) General Model Formulation

Objective Function: The objective function represents the maximization of the preference weight.

$$Maximize\ Z = \sum_{i=1}^{n}\sum_{j=1}^{m} X_{ij} W_{ij}$$

Where,

$$i = Vendor\ index, i = 1,2,3 \dots \dots n$$
$$j = Product\ index, j = 1,2,3, \dots . . m$$

$X_{ij} = 1\ or\ 0, If\ it\ is\ 1\ then\ vendor\ 1\ is\ selected\ for\ product\ j.$

$W_{ij} = Preference\ weight\ of\ vendor\ i\ for\ product\ j$

Constraints

Vendor constraint for each product:

$$\sum_{i=0}^{n} X_{ij} \geq P_j \qquad for\ j = 1,2,3, \dots . \dots m$$

Maximum products that one vendor can provide:

$$\sum_{j=0}^{m} X_{ij} \leq Q_i \qquad for\ i = 1,2,3 \dots \dots n$$

Vendor availability constraint:

$$\sum_{i=1}^{n}\sum_{j=1}^{m} X_{ij} \leq R$$

Binary and non-negativity constraint:

$$X_{ij} = \{0\ or\ 1\}$$

Where,

$P_j = Minimum\ requirement\ of\ vendors\ for\ product\ j$

$Q_i = Maximum\ number\ of\ products\ allocated\ to\ vendor\ j$

$R = Total\ number\ of\ products$

c) Case study for supplier selection for four different products

There are four suppliers and four products to be selected. For each product, we applied AHP to rank the suppliers. We use All these weighted values are in the objective function.

$$\begin{aligned} Maximize\ Z = {} & 0.334X_{11} + 0.47X_{12} + 0.112X_{13} \\ & + 0.219X_{14} + 0.332X_{21} + 0.233X_{22} \\ & + 0.621X_{23} + 0.179X_{24} + 0.401X_{31} \\ & + 0.433X_{32} + 0.116X_{33} + 0.579X_{34} \\ & + 0.279X_{41} + 0.511X_{42} + 0.624X_{43} \\ & + 0.222X_{44} \end{aligned}$$

Constraints:

$$X_{11} + X_{21} + X_{31} + X_{41} \geq 1$$
$$X_{12} + X_{22} + X_{32} + X_{42} \geq 1$$
$$X_{13} + X_{23} + X_{33} + X_{43} \geq 1$$
$$X_{14} + X_{24} + X_{34} + X_{44} \geq 1$$
$$X_{11} + X_{12} + X_{13} + X_{14} \leq 3$$
$$X_{21} + X_{22} + X_{23} + X_{24} \leq 2$$
$$X_{31} + X_{32} + X_{33} + X_{34} \leq 2$$
$$X_{41} + X_{42} + X_{43} + X_{44} \leq 2$$
$$\begin{aligned} & X_{11} + X_{12} + X_{13} + X_{14} + X_{21} + X_{22} + X_{23} + X_{24} + X_{31} \\ & + X_{32} + X_{33} + X_{34} + X_{41} + X_{42} + X_{43} \\ & + X_{44} \leq 9 \end{aligned}$$
$$X_{11}, X_{12}, X_{13}, X_{14}, X_{21}, X_{22}, X_{23}, X_{24}, X_{31}, X_{32},$$
$$X_{33}, X_{34}, X_{41}, X_{42}, X_{43}, X_{44} = 0\ or\ 1$$

d) Solution and Result

The problem formulated in case study has been solved using excel solver. The solutions

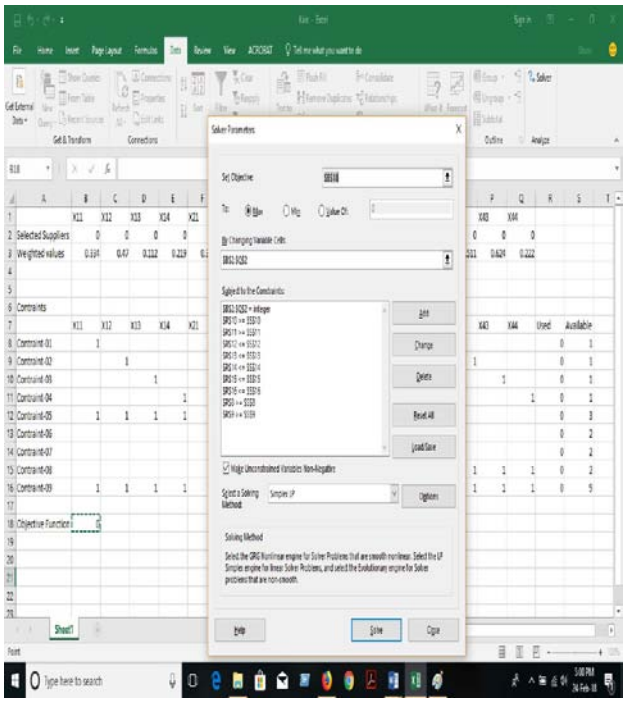

Figure 1: Excel solution for ILP problem is shown in fig 01 and fig-02.

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Table 1: Summary of resul Summary of results is shown in table -01.

Suppliers / Products	Supplier-01	Supplier-02	Supplier-03	Supplier-04
Product-01	1	0	0	0
Product-02	2	0	0	0
Product-03	0	2	0	2
Product-04	0	0	2	0

So, the company wants to select nine products from four suppliers. The result shows that product one and two are selected from vendor one, product three (two items each) is selected from two vendors (vendor two and vendor four) and product four (two items) is selected from vendor three.

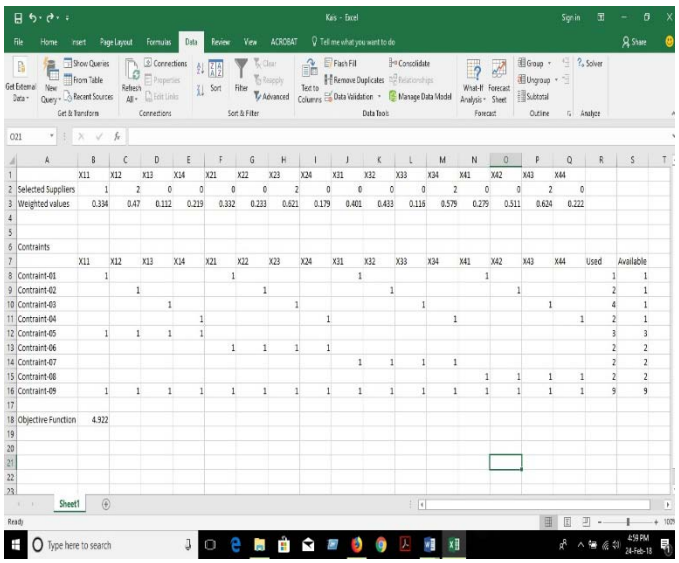

Figure 2: Final solution for ILP problem

IV. Conclusion

Vendor selection model using ILP is developed to select the vendors for a business environment having two-stage supply chain. The model is tested in knit fabrics wholesaler and is effectively working out. We can also use this model in real-life cases of other domains like automobile, textiles, electronic equipment and food industries. The model can be further improved by splitting the allocation of each product among vendors and by considering the limited capacity vendors. For more accuracy, periodic review of the key criteria should be conducted. The mathematical model used in this study work can be further extended towards multi-objective optimization to minimize overall procurement cost. Companies should choose the appropriate method for their problem according to the situation and the structure of the problem they have.

References Références Referencias

1. R. M. T. R. J. &. C. T. J. Monczka, "Supply base strategies to maximize supplier performance," International Journal of Physical Distribution & Logistics Management, vol. 23, no. 4, pp. 42-54, 1993.
2. C. R. &. R. D. S. Carter, "A framework of sustainable supply chain management: moving toward new theory," International Journal of Physical Distribution & Logistics Management, vol. 38, no. 5, pp. 360-387, 2008.
3. M. &. W. Z. Pagell, "Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars," Journal of Supply Chain Management, vol. 45, no. 2, pp. 37-56, 2009.
4. W. a. X. X. a. D. P. K. Ho, "Multi-criteria decision making approaches for supplier evaluation and selection: A literature review," European Journal of operational research, vol. 202, no. 1, pp. 16--24, 2010.
5. C. a. G. D. Gencer, "Analytic network process in supplier selection: A case study in an electronic firm," Applied mathematical modelling, vol. 31, no. 11, pp. 2475--2486, 2007.
6. F. E. a. G. S. a. K. M. a. A. D. Boran, "A multi-criteria intuitionistic fuzzy group decision making for supplier selection with TOPSIS method," Expert Systems with Applications, vol. 36, no. 8, pp. 11363--11368, 2009.
7. F. F. a. Z. J. Chaudhry S.S., "Vendor selection with price breaks," European Journal of Operational Research, vol. 70, pp. 52-66, 1993.
8. A. U., "Selecting a set of vendors in a manufacturing environment," Journal of , vol. 11, pp. 107-122, 1993.
9. D. a. T. R, "Wholesaler: A Decision Support System for Wholesale," International Journal of Physical Distribution and Logistics Management,, vol. 24, no. 10, pp. 4-12, 1994.
10. C. J. a. D. A. Weber C.A., "Non-cooperative negotiation strategies for vendor selection," European Journal of Operational Research, vol. 108, pp. 208-223, 1998.
11. C. J. a. D. A. Weber C.A., "An optimization approach to determining the number of vendors to employ," Supply Chain Management: an International Journa, vol. 5, no. 2, pp. 90-98, 2000.

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12. K. E. a. K. R. Karpak B., "An application of visual interactive goal programming: a case in vendor selection decisions," Journal of Multi-Criteria Decision Analysis, vol. 8, pp. 93-105, 1999.
13. M. V. P. a. R. s. Kumar, "A fuzzy programming approach for vendor selection problem in a supply chain," International Journal of Production Economic, vol. 101, no. 2, pp. 73-85, 2005.

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- 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.

Preparation of Eletronic Figures for Publication

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 Engineering Research Paper

Techniques for writing a good quality engineering 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 research engineering 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.

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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 though 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.

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- 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.

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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?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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