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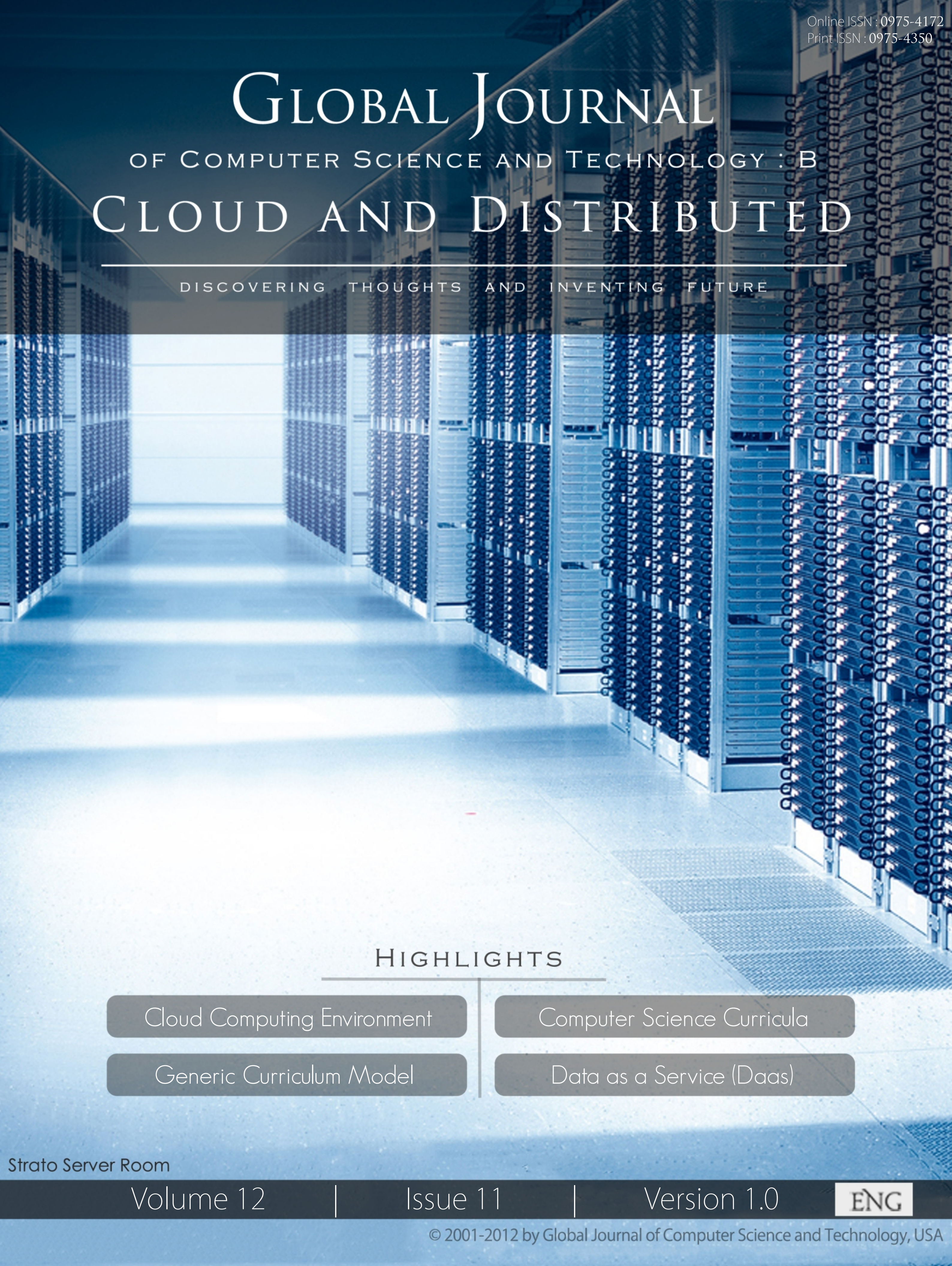

Highlights

- Cloud Computing Environment
- Computer Science Curricula
- Generic Curriculum Model
- Data as a Service (Daas)

Strato Server Room

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ENG

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Evaluating Performance of Web Services in Cloud Computing Environment with High Availability

By Sukhamrit Kaur, Kuljit Kaur & Dilbag Singh
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Abstract - This paper presents an methodology for attaining high availability to the demands of the web clients. In order to improve in response time of web services during peak hours dynamic allocation of host nodes will be used in this research work. As web users are very demanding: they expect web services to be quickly accessible from the world 24*7.

Fast response time leads to high availability of web services, while slow response time degrades the performance of web services. With the increasing trend of internet, it becomes a part of life. People use internet to help in their studies, business, shopping and many more things. To achieve this objective LAMP platform is used which are Linux, Apache, My SQL, and PHP. LAMP is used to increase the quality of product by using open
source software.

The proposed strategy will work as middle layer and provide highly availability to the web clients.

Keywords : Failover, dynamic allocation, host service provider, High availability, LAMP, Web Services.

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EVALUATING PERFORMANCE OF WEB SERVICES IN CLOUD COMPUTING ENVIRONMENT WITH HIGH AVAILABILITY

Strictly as per the compliance and regulations of:

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Sukhamrit Kaur [α], Kuljit Kaur [σ] & Dilbag Singh [ρ]

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Keywords : Failover, dynamic allocation, host service provider, High availability, LAMP, Web Services.

I. Introduction

The Internet and World Wide Web (WWW) have captured the world's imagination. Internet is represented in network as a cloud. Cloud computing is where application and files are hosted on a cloud consisting of thousand of computers and servers, all linked together and accessible via internet. Any web service or application offered via cloud computing is called a cloud service. With this simple but powerful interface, a user can download a file after accessing any web service from another computer with only a click of the mouse. Moreover, advances in technology continue to extend the functionality of the Internet. As Web services becomes increasingly popular, network congestion and server overloading have becoming significant problems. So efforts are being made to address these problems and improve web performance.

In this paper for providing high availability to the requests of web clients a new environment is developed. In order to improve in response time of web services during peak hour's dynamic distribution of host nodes will be used in this research work. As expectations of web users are at crest: they expect web services to be quickly accessible from the world 24*7 Fast response time leads to high availability of web services, while slow response time degrades the performance of web services. With the mounting tendency of internet, it becomes a part of life. People use internet to help in their studies, industry, Shopping and many more things.

To attain this objective LAMP Technology is used in which are Linux is an operating system, Apache web server, My SQL database, and PHP scripting language. LAMP is used to increase the quality of product by using open source software.

II. Research Motivation

In existing Dynasoar do not provide the solution if request from the single client occur more than a time for the same web service. Moreover, it will not provide any solution to HSP failure. So after see the causes and benefits of Dynasoar environment, try to implement it practically as Dynasoar is a theoretical concept, here trying to implement it.

III. Scope of This Research

The scope of the research is defined by the following:

1. This research work deals with load distribution and high availability for web services.
2. This research does not deal with management and security issue of web services.
3. Since it is not feasible to run the proposed strategy on large web hosting, small web sites are developed which will simulate the proposed algorithm using LAMP.
4. Different type of tests will be implemented using LAMP to test various aspects of the web services.
5. Visualization of the experimental results and drawing appropriate performance analysis.
6. Appropriate conclusion will be made based upon performance analysis.
7. For future work suitable future directions will be drawn considering limitations of existing work.

IV. Problem Definition

In this research paper a new approach is considered in which there is an active-active server. If a client accesses the same web service several times then it will consider as one and if one server fails, then client request redirected to another active server. Using active

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active server eliminated the problem of server enhancement and failover time. To achieve the objective some constraints have been setup, according to them, if access to the server goes down, another server has placed to accommodate that request. Preventing an interruption is the model of Active-Active high availability, which introduces multiple active, replicated, redundant components.

V. Literature Review

Web services (WS) [1] [2] [3] are self-contained software modules available in a network, such as the internet, which completes tasks, solves problems, or conducts transactions on behalf of a user or application. It is trajectory of communicating between two electronic devices over the web. WS interact with the sources of the information, changing the state of systems and causing real world processes to occur. As a WS network grows, its existence and performance becomes crucial to the business's core activities. So the management of WS is important for providing seamless access of the service to the user.

Web server (WSer) [setting up a web server by simon Collins [5][6][7] delivers web services to the clients. Web server is connected to the web and can be accessed to the users. It is possible that user can setup its own web server. Web server can be connected to internet or it can be a private Intranet. Both require similar software, only Intranet works in a private network and internet connected to public internet. As the traffic on web server increases, congestion will increased which may results in low response time. So to reduce these problems concept of redirection is used.

Redirection (RD) [8][9] is the process of selecting the best server that can serve user request. Web server can redirect the browser to go elsewhere to proceed the user request. Redirection happens at client side. A client is redirected only after its request has reached the home server. When user request arrives, if there is congestion, the server can redirect the client to the other web page where same request to be processed.

Redirection of a client towards a given replica of a Web service is performed after the client's request has reached the Web server storing the requested service. To improve the overall systems throughout, redirection takes place. This one of the most common use is to route traffic while migrating a web page from one server to another.

Proxy Server (PS) [10][11][12]function is to forward traffic between clients and server. Here Mysar Squid Proxy server is used. Squid is an intermediary between clients and server. As Squid is a open source software. Mysar squid is a monitoring tool that constantly monitors the request of web client, and creates the database where clearly showing for which web service client made a request. PS could help provide adequate access and response time to large numbers of users requesting previously accessed page.

High availability (HA) [13], [14] also known as failover. The key to HA be redundancy is the most common approach to increase availability. If the primary fails, one of the back-ups is promoted into that role. HA ensures automated recovery in case of failure with two different approach 1+1 and 1:1. Over the time, the file management systems and registered data became complex, and database management systems were increasingly used to store metadata.

It is often said that this generation of web services got it start from LAMP. LAMP is a stack of simple web technologies, powerful web technologies that power a lot of popular. LAMP is a popular open source solution used to run servers in which PHP is configured to run on Apache web server, using the MySQL database on Linux operating system. It is popular because of its open source nature, low cost, and its packages are easy to install and convenient to use[15] [16] [17][18].

Availability [19], [20], [21] is a reoccurring and a growing concern in software intensive systems. Cloud systems services can be turned off-line due to conservation, power outages or possible denial of service invasions. Fundamentally, its role is to determine the time that the system is up and running correctly; the length of time between failures and the length of time needed to resume operation after a failure. Availability needs to be analysed through the use of presence information, forecasting usage patterns and dynamic resource scaling.

Dynamic web service deployment functionality has been explored and developed in many different contexts, including J2EE [22], [23] and Web Services [24]. Rauch et al. [25] implemented partition cloning and partition repositories as well as a set of OS-independent tools for software maintenance using entire partitions, thus providing a clean abstraction of operating system configuration states. However, this approach is not suitable for service-oriented architectures. Moreover, the deployment of an entire OS image is expensive, and the deployment itself will seriously impact system availability. Chase et al. explore related ideas in their Cluster on Demand project [26].

Keahey et al. [27], [28] use virtual machine technology (e.g., Xen, VMware) to build virtual working environments and to provide for the dynamic management of the Grid job life cycle. Their use of virtual machines rather than JVMs to host user computations leads to somewhat different solutions from our service-oriented approach.

ROST [29], deployed in the CROWN Grid, focuses on dynamic and remote deployment for WSRF core with secure access. The developers evaluated remote deployment in the load balancing of local

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clusters. However, they did not discuss in detail the capability and availability of deployment. Weissman et al. present an architecture and implementation for a dynamic Grid service architecture based on Tomcat that extends GT3 to support dynamic service hosting (hosting and rehosting a service within the Grid in response to service demand and resource fluctuation) [30], [31].

Their implementation allows new services to be added or replaced without taking down a site for reconfiguration and allows a VO to respond effectively to dynamic resource availability and demand. But the implementation is based completely on Tomcat's container-level deployment capability, which suffers from poor performance. These and a few other projects [32], [33] are the main dynamic deployment efforts for Grid applications. Some of them clearly are not intended for a WSRF-enabled service-oriented architecture. Moreover, although some have implemented service-oriented dynamic deployment, they do not address in detail the cost, namely, the capability brought from dynamic deployment itself and the availability in dynamic Grid environments.

VI. Experimental Set-Up

In order to implement the fail-over strategy a suitable experimental set-up has been made as shown in Fig. 1. Fig. 1 take following steps to execute the jobs of the clients: The client request are monitored in such a way that each request can transparently monitor. For this process, the proxy server (Mysar) is implemented. The Network setup is as shown in Fig. 1.

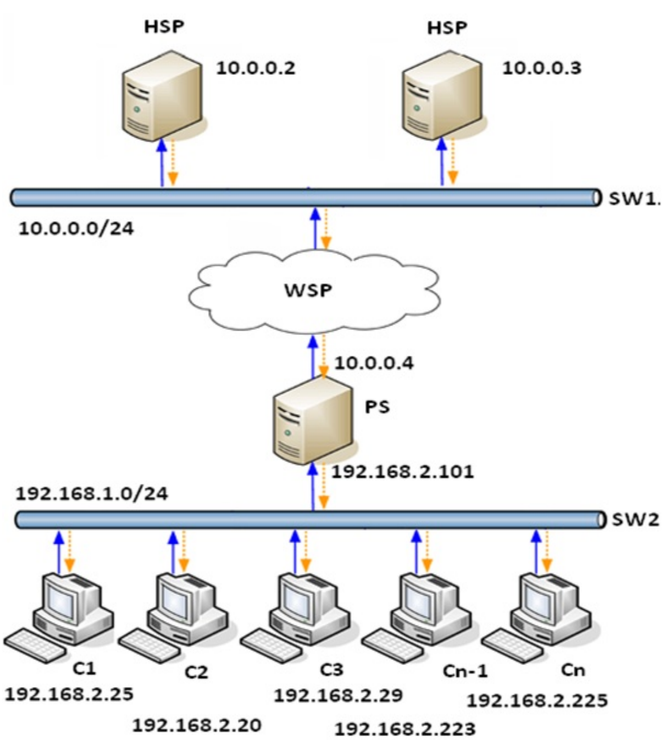

Fig. 1 : Experimental set-up

In Fig. 1 following steps are performed:

Step1: Initially clients submit their jobs to access some web services; it goes through some processes.

Step2: Requests goes to WSP, and then it will pass the given requests to the HSP.

Step3: HSP then fulfill the requests and give response to client according to desired requirement.

Step4: Multiple servers (HSP) are there in HSP end to provide services to their clients.

Step5: Policies are implemented in such a manner that the client's requests automatically redirected to other web servers. If number of requests range is reached to its peak, then it will be assumed that given server is busy or facing some sort of problem for responding client's requests.

Step6: Client's request is fulfilled with high availability with low response time.

PS: Server used for monitoring the service that user request. Clients in the network connected to the PS, after client request for web service, database is created into PS after monitoring. Then after passing through PS it goes to WSP.

VII. Simulation Results

a) Ideal server

Fig. 2 is showing that when the web server was kept Ideal i.e. no request received from the client. This is the rare condition when server was kept ideal or can be possible during off-peak hours.

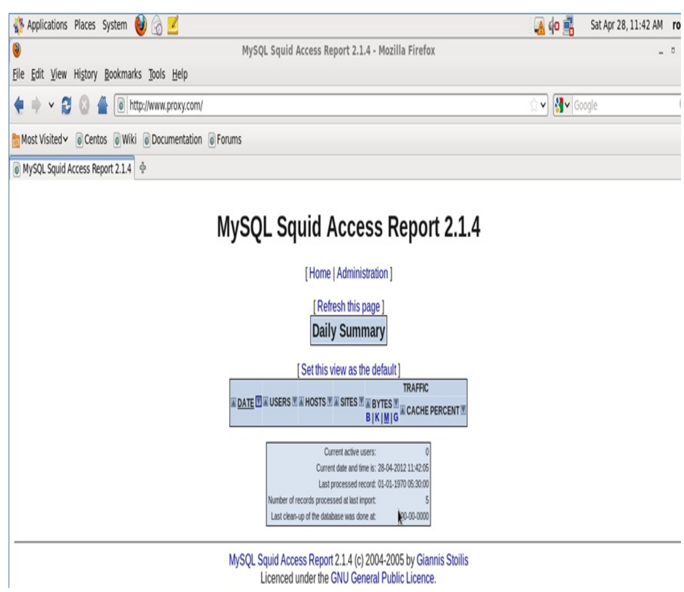

Fig. 2 : Ideal server

b) When single user request multiple times

In Fig. 3 Squid will monitor the request and server will responds once for that particular request.

c) Threshold point

In Fig. 4, 5 requests received at Server from different IP at same instant.

All the request will be process on time-sharing basis and beyond this point the server load will increase which intern reduce the performance of the server. So to overcome this redirection of Web server is mandatory.

d) Beyond Threshold

Fig. 5 demonstrating that when 6th request received at server at same instant. The 6th request will be monitor by Wire shark as mentioned below.

e) Beyond threshold

In Fig. 7 client request for amrit.sukralamata.com so counter increase by 1 by received the request from Sukh.fossfoundation.com as given in Fig. 6.

After that if client request for amrit sub-domain page will redirect to such sub-domain. And both count increase by

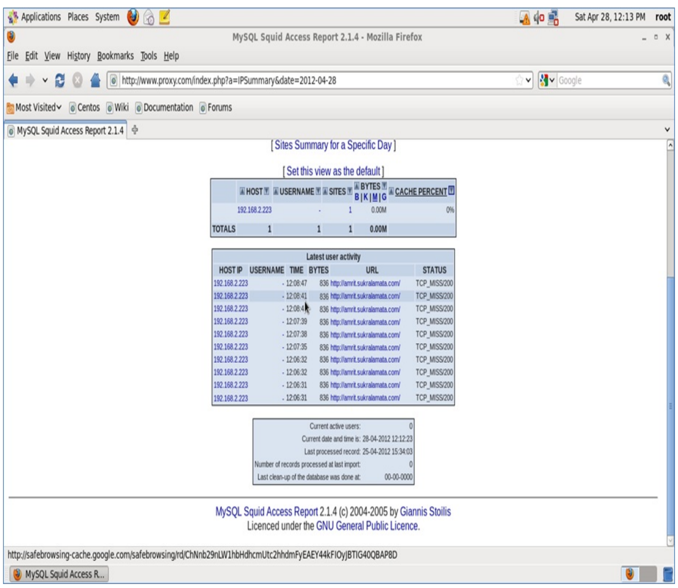

Fig. 3 : When single user request multiple times

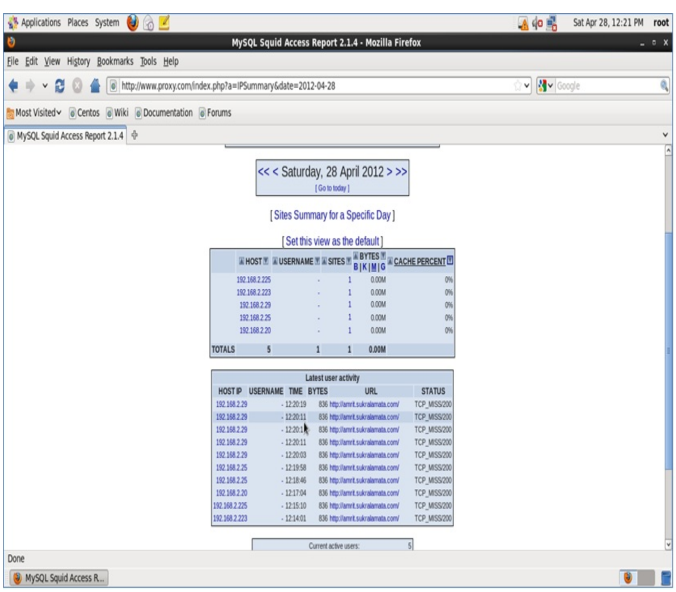

Fig. 4 : Threshold point

1. Verfiying the client request address and server response back address.

VIII. Performance Analysis

In order to do performance analysis, two comparisons table has been made in this research work. This section first give the performance comparison of developed simulator with existing methods (in which no dynamic deployment of host nodes is implemented) and later on comparison of different approaches is made using different performance metrics.

a) Comparison with existing methods

Table I is showing the comparison of existing and developed technique. Table I has shown that developed simulator will give better results than existing

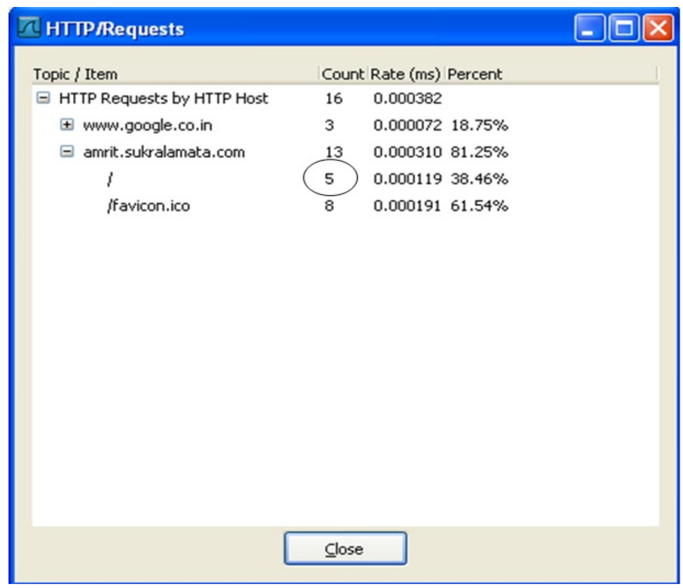

Fig. 5 : 5 client request

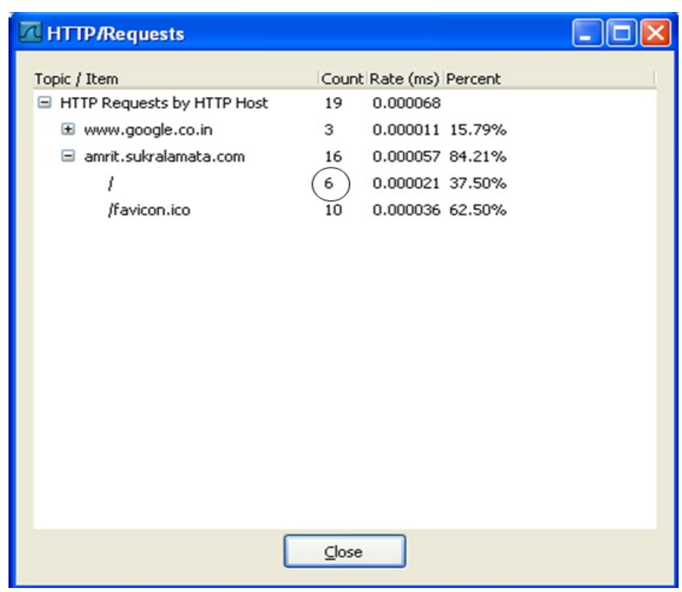

Fig. 6 : 6 client request

Table I : Feature's Comparison with Existing Method

Feature	Existing	Proposed Method
Log files	No	Yes
Failover	No	Yes
Load Balancing	No	Yes
Race condition	Yes	No
Dynamic allocation	No	Yes
Architecture	2 Tier	3 Tier
Utilization of host nodes	Low	Maximum
Average response time	High	Low
Waiting jobs	Maximum	Minimum

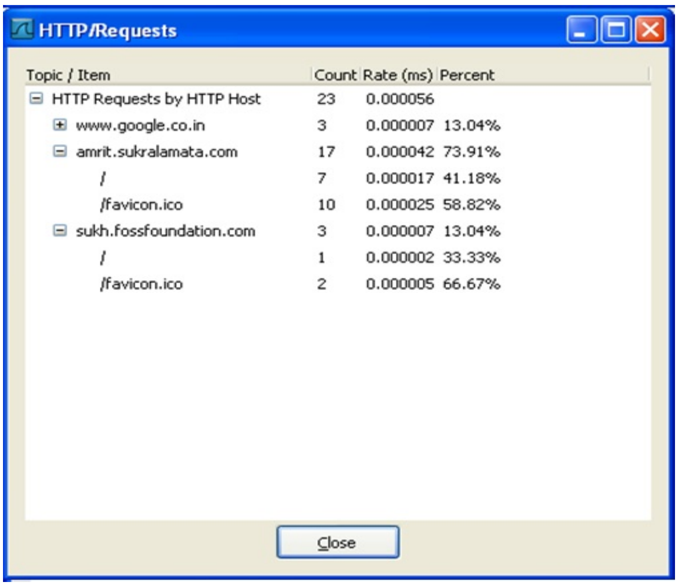

Fig. 7 : Beyond Threshold

methods. As existing technique do not provide feature of dynamic allocation, therefore node failure or congestion may result in delay in response time of client requests, by transferring request of local host to some remote node. The problem of dynamic allocation technique with broker is proved to be inefficient as migration of requests is done using random decisions and also not increase overall cost of the scenario.

b) Comparison using average response time

By taking 6 host nodes and also taking 300 client's requests performance has been measured and compared with existing methods. Table II is showing the average response time comparison at different intervals. It has been clearly shown in Table II that proposed method gives better results than existing methods. As in existing method it not possible to achieve dynamic allocation of host nodes, and without log files may cause the problem of random allocation of nodes to the requests, which may increase response time. Fig. 8 is showing the graph of average response time using different intervals, which are shown in Table II. Fig. 8 shows the difference between existing methods graphically and it is clearly shown that the proposed method gives better results than existing methods.

Table II : Average Response Time

Interval	Existing technique	Proposed
50	2	0.8
100	2.5	1.32
150	2.7	1.45
200	2.9	1.43
250	3.4	1.4
300	3.6	1.33

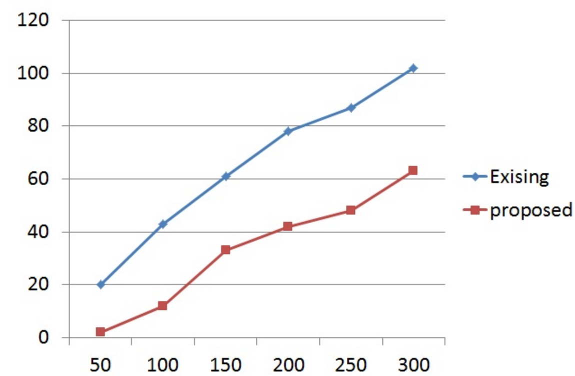

Fig. 8 : Average response time comparison

c) Comparison using number of waiting requests

Table III is showing the number of waiting requests comparison at different intervals. It has been clearly shown in Table III that proposed method gives better results than existing methods. Fig. 9 is showing the graph of number of waiting

Table III : Number of Waiting Requests

Interval	Existing technique	Proposed
50	20	0
100	42	15
150	61	37
200	78	42
250	80	49
300	103	62

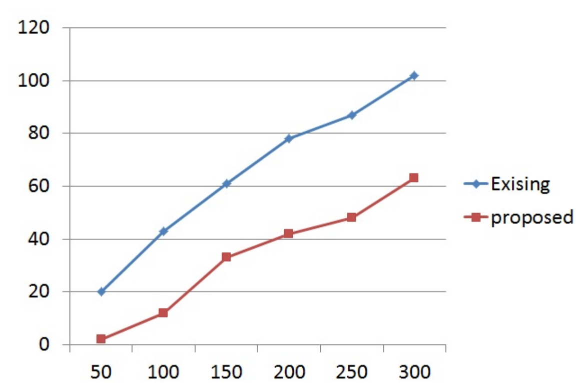

Fig. 9 : Average response time comparison

requests using different intervals, which are shown in Table III. Fig. 9 shows the difference between existing methods graphically and it is clearly shown that the proposed method gives better results than existing methods.

d) Average response time on server 1

Table IV is showing the average response time on server 1. It has been clearly shown in Table IV that as number of hits increases on given server due to congestion average response time has increased as number of hits increased. Fig. 10 is

Table IV : Average Response Time of Server 1

Number of hits	Server 1
1	4
2	68
3	128
4	130
...	...
9	1645

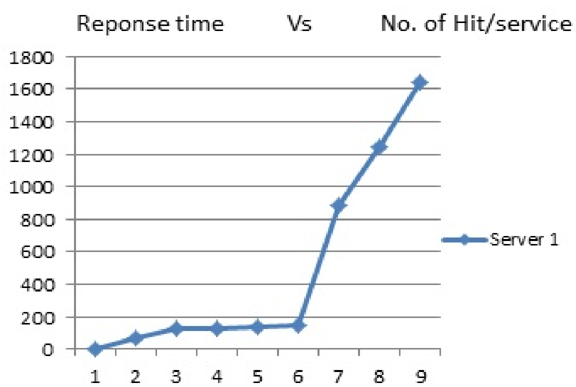

Fig. 10 : Average response time of server 1

showing the graph of average response time on server 1, which is shown in Table IV. Fig. 10 has demonstrate that as number of hits increased by some constant, average response time will increased rapidly (quite more than the increase in number of hits). Therefore proposed technique will prevent it by doing load balancing among available host nodes thus make average response time optimal as shown in Table V. Table V is showing the load balancing between different servers.

Table V : Average Response Time on Different Server

Number of hits	Server 1	Server 2	Server 3
1	4	-	-
2	68	-	-
...	...	...	...
6	144	-	-
7	-	16	-
8	-	42	-
...	...	...	...
13	-	-	42
14	-	-	78
...	...	...	...
18	-	-	140

Fig. 11: is showing the comparison graph of average response time on different servers, which is shown in Table V.

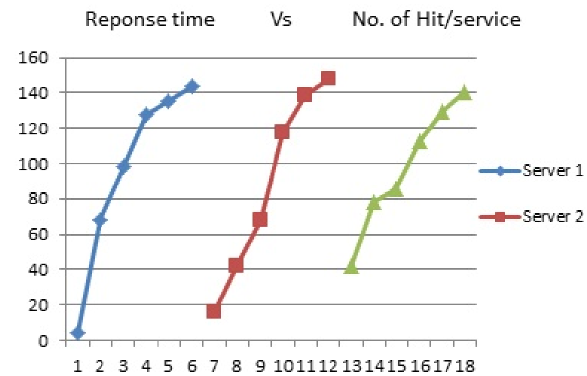

Fig. 11 : Average response time comparison

Fig. 10 has demonstrate that as number of hits increased by some constant, average response time will stay balanced due to load balancing among available nodes or servers.

e) Server Utilization (in %)

Table VI is showing the Server utilization as number of requests increases.

Table VI : Server Utilization (In %)

Number of requests	Utilization (%)
1	6
2	12
3	18
4	22
...	...
8	92
9	95

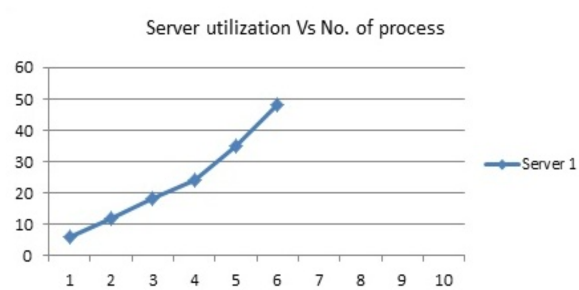

Fig. 12 : Server Utilization (in %)

Fig. 12 is showing the server utilization, which is shown in Table V. Fig. 12 has demonstrate that as number of requests increased by some constant, utilization is also increased by some multiple constant but after the threshold (the capacity of server) it will increases rapidly.

Table VII is showing the Servers utilization as number of requests increases by implementing proposed technique.

Fig. 13 is showing the server utilization, which is shown in Table VI. Fig. 13 has demonstrate that as number of requests.

Table VII : Server Utilization (In %) Among Two Servers

Number of requests	Server 1	Server 2
1	6	-
2	12	-
...	...	...
6	48	-
7	-	6
8	-	13
...	...	...
12	-	45

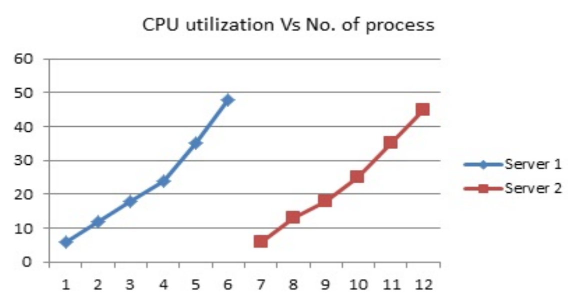

Fig. 13 : Server Utilization (in %) among two servers

increased by some constant, utilization is also increased by some multiple constant but after the threshold (the capacity of server) proposed strategy will do balance the load among other active servers.

IX. Conclusion and Future Directions

This paper proposes a smart strategy for web services using dynamic allocation techniques. Using LAMP, a new environment has been developed that implement the proposed method. Performance comparison of existing methods has been made with the proposed method. It has been concluded with the help of performance metric's comparison that the proposed failover strategy gives good results than existing methods.

In this paper homogeneous host nodes has been considered for simulation environment, in future work heterogeneous nodes will be used for better results.

X. Contributions

This section will describe the contributions of this research work to science and practice.

A literature review has been conducted on the approached of high availability in web services. The results of this literature research show that web services are in its infancy, because the structured search revealed minimal peer-reviewed information on these topics. Regardless, this research has refined three concepts from the literature and transformed them into dimensions that are usable in the context of web services. The most contributing dimension is based on concept from the research area of fail-over strategies.

Another contribution of this research is related to the LAMP. This research uses LAMP in order to provide high availability to the demands of the clients. With the identification of congestion in web services, this research shows which problems can occur when congestion occur. This type of research has not been conducted before and it is important for entities that wish to know what the high availability limitations of web services.

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Missing Elements of Computer Science Curricula 2013

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Abstract - Rapidly expanding computing domain has forced educational institutions to up-grade existing curricula of computing degree programs. Recently, a joint task force of Association for Computing Machinery and IEEE-Computer Society has published the Strawman Draft of Computer Science Curricula 2013. The Draft has introduced some new ideas to keep computing curricula modern and relevant. The recommended curricula have designed in the light of 6% response rate of the conducted survey. This paper has pointed out some important aspects which need attention to meet the challenges of the 21st century. These aspects include an Ad-hoc approach towards the core body of knowledge, incomplete curriculum guidelines, over-ambitious contents and learning outcomes. Some other missing aspects include computing dispositions, global education, 21st century skills, guideline for inclusion and the hidden curriculum. It is believed the recommendations of this paper may generate some thought provoking ideas to make the computing curricula more robust and effective.

Keywords : Computing Curriculum, Computer Science Curricula 2013, Computing Model Curriculum, Dispositions in Computing, Hidden Curriculum in Computing, Global Education in Computing, Flexible Computing Curriculum.

GJCST-B Classification: K.3.2

MISSING ELEMENTS OF COMPUTER SCIENCE CURRICULA 2013

Strictly as per the compliance and regulations of:

Missing Elements of Computer Science Curricula 2013

Muhammad Anwar-ur-Rehman Pasha [α] & Shaheen Pasha [σ]

Abstract - Rapidly expanding computing domain has forced educational institutions to up-grade existing curricula of computing degree programs. Recently, a joint task force of Association for Computing Machinery and IEEE-Computer Society has published the Strawman Draft of Computer Science Curricula 2013. The Draft has introduced some new ideas to keep computing curricula modern and relevant. The recommended curricula have designed in the light of 6% response rate of the conducted survey. This paper has pointed out some important aspects which need attention to meet the challenges of the 21st century. These aspects include an Ad-hoc approach towards the core body of knowledge, incomplete curriculum guidelines, over-ambitious contents and learning outcomes. Some other missing aspects include computing dispositions, global education, 21st century skills, guideline for inclusion and the hidden curriculum. It is believed the recommendations of this paper may generate some thought provoking ideas to make the computing curricula more robust and effective.

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I. Introduction

Traditionally, computing is used as an umbrella term to represent the following five disciplines:

1. *Computer Engineering* (*CE*) focuses on computing hardware and associated computing aspects.
2. *Computer Science (CS)* focuses on computing theory, methodology, innovation, development (programming) of technologies and applications, and applying computing to new disciplines.
3. *Information Systems (IS)* focuses on applying computing in organizations and organizational information management.
4. *Information Technology (IT)* focuses on solving organizational computing challenges by integrating technologies into solutions and deploying and maintaining the solutions.
5. *Software Engineering (SE)* focuses on developing large complex software systems.

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Computing is a rapidly progressing domain. In recent years many significant developments have been made and many new concepts have been introduced. For example, "Computational Lens" (Karp, 2011) which articulates a new relationship between computer science and other sciences, "Ternary Computing" dealing with computing for the masses (Li, 2010), "e-Science" managing massive experimental data and collaborating via the Net, "Computational Thinking" (Wing, 2006; 2008), Cloud Computing (Li & Zhang, 2009), Biological Computing (Garfinkel, 2000), etc. In parallel, the integration of computing in other disciplines introduces new disciplines such as "Computational-x" (e.g., computational mathematics, computational physics, computational finance, etc.) and "x-Informatics" (e.g., bio-informatics, dental-informatics, clinical-informatics, etc.) (ACM & IEEE-CS, 2012). Many such developments compel the international community to update the curricula of computing degree programs to meet the needs of the time.

The practice of developing a model curriculum in the computing domain started in 1965 when the Association for Computing Machinery (ACM) for Computer Science curriculum published their recommendations (ACM, 1965). Since then the international community has developed many model curricula to keep computing discipline up-to-date. Recently, the Joint Task Force on Computing Curricula Association for Computing Machinery and IEEE-Computer Society has published the Strawman Draft of Computer Science Curricula 2013 (ACM & IEEE-CS, 2012). The recommendations made in this Draft have introduced some new ideas to keep computing curricula modern and relevant. The Draft has invited suggestions & recommendations from the international community to be included in the Ironman report going to be released in 2013. In this paper we have pointed out some short comings of the recommended curricula and made recommendations to make it more robust and effective. We believe the recommendations made in this paper may generate some thought provoking ideas for developing model curriculum for computing degree programs.

The organization of this paper is as follow. A review of the computing model curriculum development efforts is presented in the next section. Some important aspects of the Strawman Draft are outlined in the next section. Section 4 has identified some shortcomings of the curriculum recommended in the Draft. Concluding discussion and recommendations are presented in the last section.

II. Computing Model Curriculum Development

In computing domain, the history of model curriculum development started with the publication of the recommendations of the ACM for Computer Science curriculum (ACM, 1965). Since then many efforts have been made to keep the computing curriculum up-to-date. These efforts include, for example, Curriculum 68 (ACM, 1969), IEEE Computer Society Education Committee/Model Curriculum (1976), Curriculum recommendations for the Undergraduate Program in Computer Science (ACM, 1977) and Curriculum 78 (ACM, 1979), IEEE Computer Society Educational Activities Board/Model Program (IEEE-CS, 1983) and ACM Task Force's Report on the Core of CS (Dening & et al.,1988)

In 1991, ACM and IEEE-CS jointly published Computing Curricula 1991 for Bachelor's degree programs in CS and CE (ACM/IEEE-CS, 1991). In 2001, ACM and IEEE joint task force produced Computing Curricula 2001 (ACM/IEEE-CS, 2001) four distinct disciplines - CS, CE, IS and SE. In 2005, once again ACM & IEEE jointly published the Computing Curricula 2005 (ACM/IEEE-CS, 2005) which included IT as an independent discipline. The interim review effort (2008) (ACM/IEEE-CS, 2008) and the Strawman Draft of CS Curricula 2013 (ACM/IEEE-CS, 2012) are among the latest efforts to keep computing curricula modern and relevant.

III. CS Curricula 2013: The Strawman Draft

The Draft has provided a comprehensive revision of the existing curricula. It is prepared in the light of following guidelines, as reported in (ACM/IEEE-CS, 2012):

- The "Big Tent" view of CS to accommodate the challenges of emerging disciplines include more cross-disciplinary work new programs of the form "Computational Biology," "Computational Engineering," and "Computational X".
- Flexible models for different curricula without losing the essence of a rigorous CS education.
- To identify and describe existing successful courses and curricula to show how relevant knowledge units are addressed and incorporated in actual programs.
- To be applicable in a broad range of geographic and cultural contexts, understanding that curricula exist within specific institutional needs, goals, and resource constraints.

The recommended curricula are based on following ten principles:

1. Computer Science curricula should be designed to provide students with the flexibility to work across many disciplines.
2. Computer Science curricula should be designed to prepare graduates for a variety of professions, attracting the full range of talent to the field.
3. CS2013 should provide guidance for the expected level of mastery of topics by graduates.
4. CS 2013 must provide realistic, adoptable recommendations that provide guidance and flexibility, allowing curricular designs that are innovative and track recent developments in the field.
5. The CS2013 guidelines must be relevant to a variety of institutions.
6. The size of the essential knowledge must be managed.
7. Computer Science curricula should be designed to prepare graduates to succeed in a rapidly changing field.
8. CS2013 should identify the fundamental skills and knowledge that all computer science graduates should possess while providing the greatest flexibility in selecting topics.
9. CS2013 should provide the greatest flexibility in organizing topics into courses and curricula.
10. The development and review of CS2013 must be broadly based.

The Draft has organized the Body of Knowledge into a set of 18 Knowledge Areas: "

1. AL - Algorithms and Complexity
2. AR - Architecture and Organization
3. CN - Computational Science
4. DS - Discrete Structures
5. GV - Graphics and Visual Computing
6. HC - Human-Computer Interaction
7. IAS - Information Assurance and Security
8. IM - Information Management
9. IS - Intelligent Systems
10. NC - Networking and Communications
11. OS - Operating Systems
12. PBD - Platform-based Development
13. PD - Parallel and Distributed Computing
14. PL - Programming Languages
15. SDF - Software Development Fundamentals
16. SE - Software Engineering
17. SF - Systems Fundamentals
18. SP - Social and Professional Issues

Many of these Knowledge Areas are derived from CS curriculum 2001 (ACM/IEEE-CS (2001) and CS curriculum 2008 (ACM/IEEE-CS, 2008) but have been revised—in some cases quite significantly new.

The Draft has introduced three levels of knowledge description: Tier-1 Core, Tier-2 Core, and

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Elective. Topics have been identified as either "core" or "elective". The draft suggests that a curriculum should include all topics in the tier-1 core and ensure that all students cover this material. Also, all or almost all topics in the tier-2 core should be taught to all students. It has also been suggested that the curriculum should include significant elective material as covering only the "core" topics is insufficient for a complete curriculum (ACM/IEEE-CS, 2008).

IV. ShortComings of the Cs Curriculum 2013

The Draft is prepared to keep the computing curricula up-to-date and relevant but the following aspects may raise questions about its effectiveness.

a) Low response rate

The Draft reports that "the survey was sent to approximately 1500 Computer Science (and related discipline) Department Chairs and Directors of Undergraduate Studies in the United States and an additional 2000 Department Chairs internationally. We received 201 responses, representing a wide range of institutions". In this case the response rate is just 6% which raises the question of reliability, validity and acceptability of its recommendations. Studies suggest that an achievable and acceptable rate is 75% for interviews and 65% for self-completion postal questionnaires (Arber, 2001; Sitzia & Wood,1998). Similarly, Mundy (2002) comments that "There's no magic figure on response rates. Higher is better: 60% would be marginal, 70% is reasonable, 80% would be good, 90% would be excellent" (p. 25). The recommendations made in the light of 6% response rate can only represent the point of view of a specific community. It cannot be generalized.

b) An Ad-hoc approach towards the core body of knowledge

The Draft has added two new knowledge areas in the core body of knowledge: "Information Assurance and Security" and "Parallel and Distributed Computing" as the survey respondents indicated a strong need of these topics. There is no doubt the identified areas are important but the concept of computing is evolving and expanding with an unprecedented pace. The approach of adding new concepts as they emerge will make the computing core over-crowded and unmanageable.

c) Incomplete curriculum guidelines

The Draft includes guidelines regarding knowledge areas, curricula and course exemplars, institutional challenges, key principles & professional practice, and characteristics of graduates. As a normal practice, an effective curriculum provides guidelines for students' learning, contents for learning, sequence of courses of study, instructional methods and activities, instructional resources, educational settings, evaluation methods for assessing student learning, accountability measures for teaching-learning processes, etc. (Talbot, 2004; HEC, 2012; UNESCO, 2012). Whereas, the recommendations of the Draft covers only few of these aspects.

d) Inconsistency in the use of terms 'Computing' and 'Computer Science'

A substantial amount of research efforts have been carried out to define the distinctive features and characteristics of five key disciplines of computing. In the Draft, the term "computing" and "computer science" are used interchangeably that make it unclear that the proposed recommendations are for 'Computer Science" degree program or for the whole spectrum of computing related degree programs. This aspect is making its scope ambiguous.

e) Over-ambitious contents and learning outcomes

Topics included in the defined knowledge areas can be considered over-ambitious and seems difficult to cover within the proposed time span.

f) Dispositions: an ignored aspect

The concept of dispositions has become an important element of an effective curriculum. It can be thought of as habits of mind or tendencies to respond to certain situations in certain ways. For example, curiosity, friendliness, bossiness, meanness, and creativity are dispositions, rather than of skills or items of knowledge (Katz, 1995). Preparing students for having the disposition to be a programmer is more important than having programming skills. This important aspect is missing from the proposed curriculum.

g) Other missing aspects

Global education, 21st century skills, inclusive education, and hidden curriculum are among the important aspects of 21st century education. These aspects have not been addressed in the Draft.

V. Discussion & Recommendations

Computing is a rapidly changing domain and will continue to change for the foreseeable future. Both institutions and faculty are striving to address how to meet the needs of the students studying in computing and other newly emerging disciplines as they are being considered responsible of producing well-rounded computing graduates equipped with professional competencies ready to work in a more holistic way than simply demonstrating technical skills. For this purpose they need a flexible curriculum model that would take a broader view of the field and provides guidelines to meet the challenges of 21st century education. The ACM and IEEE-CS joint task force's effort of producing the Straman draft of Computer Science Curricula 2013 is a valuable attempt in this direction. Yet below discussed aspects need to be considered before producing a final draft.

As discussed earlier, the Draft has increased the size of the core body of knowledge by adding new knowledge areas. In recent years many new concepts have been introduced and will continue in the foreseeable future. The approach of adding new knowledge areas in the computing core will make it unmanageable if new knowledge areas continue to emerge. The wisdom suggests that in place of increasing the size of the core, a more appropriate approach has to be adopted for accommodating new ways of thinking, application and evolution of computing. We believe, in place of increasing the size of the computing core, some common knowledge areas should be identified which could strengthen students' conceptual understanding required to study higher level computing concepts. These common knowledge areas should be equally important for both the students of core computing disciplines and the students studying in newly emerged fields. In this regard we recommend that the computing core should be based on following knowledge areas which are essential for a whole range of computing degree programs including "computational-x" and "x- informatics". These knowledge areas are:

1. Principles of Computing & Programming
2. Principles of Operating Systems
3. Principles of Database Systems
4. Principles of Software Engineering
5. Principles of Human Computer Interaction
6. Principles of Web Technologies.

Keeping a small core will allow institutions to include newly emerging areas like quantum computing, bilogical, cloud computing, etc. It will also allow them to produce their own brands through offering special topics or training. Branding in higher education is a topic of great interest among the higher education community (Brunzel, 2007; Lockwood & Hadd, 2007); Temple, 2006). We also propose the following curriculum structure for computing degree programs:

- Core Compulsory Courses (17%)
- Foundation Elective Courses (11%)
- Interdisciplinary Computing Supportive Elective Courses (11%)
- General Education Elective Courses (9%)
- Domain Specific Elective Courses (38%)
- Specialization/Major Elective Courses (9%)
- Capstone Project/Internship (5%)

For the selection of course contents "Selective Abandonment" strategy (Lovely & Smith, 2004) is strongly recommended as it allows teachers to prioritize the content of instructional material into three categories: essential material must be covered and have top priority, supportive may be dealt with in conjunction with other material or as a cooperative or independent learning experience, and extraneous material can be included as time allows.

It could be argued that we have eliminated the traditional core areas like computer programming, data structure and algorithms, data-communication, digital logic design and computer organization, etc. We believe these subjects have different standpoints in different domains. For example, low level computer programing is more useful for computer engineering students as compared to the students of information systems. Time has come to realize that to develop an appropriate mindset the students need to study material related to that particular domain (Pasha & Pasha, 2012). Such topics could be covered under the category of 'Domain Specific Elective Courses'. This way institutions can offer different contents to the students of different degree programs. Similarly, courses like discreet structures, data-communication, digital logic design and computer organization could be offered under 'Computing Supporting Elective Courses'. Science, Mathematics, etc. could be covered under 'Interdisciplinary supporting Elective Course'. Course like Philosophy, Psychology, Sociology, Comparative Study of Religions, etc. could be taught under 'General Education Electives'. The Capstone project will allow students to demonstrate the knowledge and skills they have learnt during the course of their study.

Jackson (2008) argues that higher education has a responsibility to help students to develop and promote their understanding and awareness of their own creativities, identity and lifelong learning experiences. He further comments "Preparing students for a lifetime of working, learning and living in uncertain and unpredictable worlds that have yet to revealed is perhaps one of the greatest responsibilities and challenges confronting universities all over the world." Katz (1993) argues that "One of the major questions to be addressed when developing a curriculum is, What should be learned?" One way to answer this question, as (Katz, 1991) explains, "is to adopt at least four types of learning goals, those related to knowledge, skills, dispositions, and feelings. The acquisition of both knowledge and skills is taken for granted as an educational goal, and most educators would also readily agree that many feelings (e.g., self-esteem) are also influenced by school experiences and are thus worthy of inclusion among learning goals. However, dispositions are seldom included, although they are often implied by the inclusion of attitudes (e.g., attitudes toward learning) as goals" (Katz, 1993).

The role of dispositions in computing education is very important. For example, having the disposition to be a programmer is much better that just having programming skills. Similarly, and, having the disposition to be a software engineer is much batter than just having software engineering skills. Katz (1995) pointed out that "Dispositions are not learned through formal instruction or exhortation. Many important dispositions are in-born in all children like the dispositions to learn and to make sense of experience." Many dispositions that most adults want children to acquire or to strengthen - for example, curiosity, creativity, cooperation, openness, friendliness—are learned primarily from being around people who exhibit them; they are strengthened by being used effectively and by being appreciated rather than rewarded (Kohn, 1993).

To strengthen the dispositions computing students should have, they must be provided with the opportunity to express the dispositions in their behavior. When manifestations of the dispositions occur, they can be strengthened as the students observe their effectiveness and the responses to them and experiences satisfaction from them. Dweck (1991) argue that an effective curriculum can strengthen certain dispositions by setting learning goals rather than asking teachers to set some performance goals. Therefore, it is strongly recommended that the forthcoming Iransman Draft must identify those dispositions which are essential for computing students and make part of the curriculum.

Hidden Curriculum is an important component of any educational program (Jackson, 1968). Hidden curriculum deals with the elements of socialization embedded in the curriculum and are imparted to students through daily routines, curricular content, and social relationships, yet are not part of the formal curricular content. Emile Durkheim views educational systems reflect underlying changes in society because the systems are a construct built by society, which naturally seeks to reproduce its collectively held values, beliefs, norms, and conditions through its institutions (Giddens, 1972). He further comments, "Society can survive only if there exists among its members a significant degree of homogeneity; education perpetuates and reinforces this homogeneity by fixing in the child, from the beginning, the essential similarities collective life demands". He also comments that socializing children to hold particular values such as those of "achievement" and "equality of opportunity" is necessary to this consensus and is the primary function of education (Giddens, 1972).

The Draft has addressed the issue of professional practices and considers it as a discrete area which has to be treated explicitly. We believe topics like professional ethics, soft skills, public speaking, critical thinking & reasoning, modern literacies, inter-personal attributes, entrepreneurship, attitude towards lifelong learning, other life & social skills should not be considered discrete items and to be taught independently. Such concepts should be threaded into the entire fabric of the curriculum and taught as a hidden curriculum. This approach will, on the one hand, make room for other valuable concepts. On the other hand, it will make students responsible citizen, ethically sound professionals, and sociable members of the society.

The biggest pitfall in selecting the contents and learning outcomes for any learning activity is to be over-ambitious for the time allocated. The over-ambitious contents and learning outcomes is another aspect of the Draft which must be addressed. Let's take the example of "Algorithms and Complexity (AL)" knowledge area. The Draft has proposed the following contents, learning outcomes and number of hours.

a) *AL/Basic Analysis [2 Core-Tier1 hours, 2 Core-Tier 2 hours]*

i. *Topics : [Core-Tier1]*

- Differences among best, average, and worst case behaviors of an algorithm
- Asymptotic analysis of upper and average complexity bounds
- Big O notation: formal definition
- Complexity classes, such as constant, logarithmic, linear, quadratic, and exponential
- Empirical measurements of performance
- Time and space trade-offs in algorithms

ii. *[Core-Tier2]*

- Big O notation: use
- Little o, big omega and big theta notation
- Recurrence relations and analysis of recursive algorithms
- Some version of a Master Theorem

iii. *Learning Outcomes*

1. Explain what is meant by "best", "average", and "worst" case behavior of an algorithm. [Knowledge]
2. In the context of specific algorithms, identify the characteristics of data and/or other conditions or assumptions that lead to different behaviors. [Evaluation]
3. Determine informally the time and space complexity of simple algorithms. [Application]
4. Understand the formal definition of big O. [Knowledge]
5. List and contrast standard complexity classes. [Knowledge]
6. Perform empirical studies to validate hypotheses about runtime stemming from mathematical analysis. Run algorithms on input of various sizes and compare performance. [Evaluation]
7. Give examples that illustrate time-space trade-offs of algorithms. [Knowledge]
8. Use big O notation formally to give asymptotic upper bounds on time and space complexity of algorithms. [Application]

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9. Use big O notation formally to give average case bounds on time complexity of algorithms. [Application]
10. Explain the use of big omega, big theta, and little o notation to describe the amount of work done by an algorithm. [Knowledge]
11. Use recurrence relations to determine the time complexity of recursively defined algorithms. [Application]
12. Solve elementary recurrence relations, e.g., using some forms of a Master Theorem. [Application]

Teaching of the above mentioned course contents and expecting the mentioned learning outcomes from students in just 4 hours seem unrealistic. We believe the proposed learning outcomes require more time on the part of both teachers and students for their completion than is mentioned. Knight (2002) argues that in the higher education contents should be offered in order to maximize the chance that learners will experience coherence, progression and deep learning. If the contents and outcomes are over-ambitious compare to the time available, these cannot go without compromising the essential characteristics of the learning experience (Barnett, et al., 2001; Pasha & Pasha, 2012a). Di Carlo (2009) argues that attempting just to cover the overcrowded course contents limit students to simply learning facts without developing the ability to apply their knowledge to solve novel problems. It puts an extra cognitive load on students (Chandler & Sweller, 1991). and makes both faculty and students overburdened (Gibbs, 1981; Ironside, 2004). As a result, the students' academic achievements get effected (Apple, 2001; Jones, 2008). For an effective learning students need to be engaged in higher order cognitive activities which are related to the upper half of Bloom's taxonomy (Bloom & David, 1959; Pasha & Pasha, 2012a).

The high pace of knowledge exploration, inventions of new technologies, and the convergence of computing and other disciplines, the emergence of new domains & disciplines have introduced new challenges to curriculum development for degree programs. These trends demand a flexible approach for curriculum development which not only meets the existing challenges but also have the potential to accommodate the future needs as well (Pasha & Pasha, 2012a).

We need to realize that the 21st century has been labeled as an era of knowledge economies which have manifested itself in many different ways like science and technology bonding has become stronger than ever before, innovation has become more important for economic growth and competitiveness, continuing education and lifelong learning have got unprecedented importance in organizational practices, investment in intangible assets has become more valuable than investments in fixed capital (Pasha & Pasha, 2012b). These trends have led to an increased competition in the business world (Utz, 2006). Also the relationship between knowledge and technology has become more evident. Although, the economic activities all over the world are increasingly becoming knowledge oriented but the degree of knowledge and technology integration into economic activity is now so great that knowledge & technology have been recognized as the drivers of productivity and economic growth (Kogut & Zander, 1992; Nonaka, & Takeuchi, 2002; Choo, 2002; Zítek & Klímová, 2011). In today's world, the basic economic resource - the means of production - is no longer capital, nor natural resources, nor labor. It is and will be the knowledge workers who possess high levels of education and/or expertise in a particular area, and who use their cognitive skills to engage in complex problem solving. Such knowledge workers will be the assets of the organization (Drucker, 2006). In this sense transforming computing students into valuable knowledge workers should be one of the key purposes of a curriculum (Pasha & Pasha, 2012c).

Time has come to realize the changing patterns of 21st century universities education which have removed the identity of place, the identity of time, the identity of the scholarly community, and the identity of the student community. For accommodating these changes, we need to understand the five contemporary competing epistemological pressures on the higher education curriculum. Brigges (2000) suggests that the future of the higher education curriculum will hang significantly on the way in which this competition is resolved:

1. The deconstruction of the subject, as reflected in, for example, the modularization of the curriculum;
2. The cross-curricular `key' skills movement;
3. The learning through experience movement and the shift of the seat of learning outside the academy;
4. The anarchic potential of web-based learning; and
5. The reaffirmation of the subject as the academic and organizational identity.

We believed, similar to other disciplines, people from computing domain must appreciate these challenging aspects and find practical ways to resolve these conflicts. We also believe giving considerations to the following aspects would make computing curricula more agile, responsive and accommodating:

The curriculum should:

- Equip students with 21st century skills;
- Include a hidden curriculum for teaching the elements of socialization & other life skills;
- Include the aspects of Global Education & Multicultural education;
- Promote inclusive education and define measures to meet the needs of the students with special needs;

- Allow institutions to integrate the concept of branding within their degree programs.

We believe that the recommendations made in this paper may provide some useful ideas to be included in the Ironman Draft which is going to be released in 2013 [6].

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A Generic Curriculum Model for Computing Degree Programs

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Abstract - The current literature shows the existing curriculum models are unable to meet the needs of the today's dynamic & complex education as the society is more open, diverse, multidimensional, fluid and more problematical. A generic curriculum model is proposed for all types of computer degree programs. The proposed model defines five meta-processes, a flexible structure for hidden and formal curriculum, and innovative ideas for branding and capstone project. Taking a futuristic approach and keeping an eye on the emerging needs of today's knowledge driven society, the proposed model aims to transform students into valuable plug-n-play knowledge workers equipped with up-to-date knowledge, marketable skills, valuable competencies, unique expertise, globally compatible dispositions and culturally and professionally acceptable values. Through introducing competencies, expertise and dispositions among threshold standards we have given a new starting point for curriculum experts to extend the virtual boundaries of teaching-learning environment from classrooms to work-place environments. The proposed model not only meets the existing needs of the core computing disciplines but also accommodate the implications of newly emerging disciplines. Its flexible structure allows both institutions and faculty to decorate it according to their requirements.

Keywords : Computing Curriculum, Computing Model Curriculum, Dispositions in Computing, Hidden Curriculum in Computing, Global Education in Computing, Flexible Computing Curriculum.

GJCST-B Classification: K.3.2

A GENERIC CURRICULUM MODEL FOR COMPUTING DEGREE PROGRAMS

Strictly as per the compliance and regulations of:

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Muhammad Anwar-ur-Rehman Pasha [α] & Shaheen Pasha [σ]

Abstract - The current literature shows the existing curriculum models are unable to meet the needs of the today's dynamic & complex education as the society is more open, diverse, multidimensional, fluid and more problematical. A generic curriculum model is proposed for all types of computer degree programs. The proposed model defines five meta-processes, a flexible structure for hidden and formal curriculum, and innovative ideas for branding and capstone project. Taking a futuristic approach and keeping an eye on the emerging needs of today's knowledge driven society, the proposed model aims to transform students into valuable plug-n-play knowledge workers equipped with up-to-date knowledge, marketable skills, valuable competencies, unique expertise, globally compatible dispositions and culturally and professionally acceptable values. Through introducing competencies, expertise and dispositions among threshold standards we have given a new starting point for curriculum experts to extend the virtual boundaries of teaching-learning environment from classrooms to work-place environments. The proposed model not only meets the existing needs of the core computing disciplines but also accommodate the implications of newly emerging disciplines. Its flexible structure allows both institutions and faculty to decorate it according to their requirements.

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I. Introduction

Curriculum development has always been a topic of great concern among academia. In literature many curriculum models have been proposed to increase academic rigor and students' academic achievements (Tyler, 1949; Taba, 1962; Wheeler, 1967; Walker, 1971; Eisner, 1991; Biggs, 1996; Bell & Lefoe, 1998; Parker, 2003; Talbot, 2004; Smith & Ragan, 2005; Wiggins & McTighe, 2010; HEC, 2012). Being a rapidly expanding field, academia from computing domain is also striving to keep computing curricula up-to-date and relevant. Since 1965 (ACM, 1965) various model curricula are developed like CC-2001 (ACM/IEEE, 2001), ISs Model Curriculum 2002 (ACM/AIS/AITP, 2002), Curriculum Guidelines for SE 2004 (ACM/IEEE, 2004a), Curriculum Guidelines for CE 2004 (IEEE/ACM, 2004b), Computer Science Curriculum 2008 (ACM/IEEE-CS, 2008), Curriculum Guidelines for Information Systems 2010 (ACM/AIS, 2010), and Computer Science Curricula 2013 (ACM/IEEE-CS, 2012).

These curricula mainly identify a core body of knowledge (CBOK), curriculum structure, implementation strategies, threshold standards, and professional practices. The threshold standards are defined considering only knowledge & skills. In some curricula Bloom's (1956) taxonomy is used to define these standards whereas some curricula have used very generic statements like "[graduates should] Demonstrate a requisite understanding of the main body of knowledge and theories of computer science" (ACM/IEEE, 2001, p66). Such generic statements cannot define the level of knowledge and skills. The CBOK, curriculum structure and implementation strategies are different in each discipline. As a common practice new knowledge areas have been added in the CBOK as new concepts emerge which increasing the size of the CBOK. Professional practices are considered as a discrete knowledge area to be taught separately.

Although, no specific approach has been indicated, these curricula appear to be developed according to Tyler's (1949) product model. Dennis, (2002) comments Tyler's model is highly structured and systematic. It gives a complete paradigm with all the major considerations. It is a closed system, easy to follow and being considered very effective for public education. The model follows the rationality rules - everything is predictable, ordered, measurable, objective and scientific. It is performance based, behaviourist and outcome focused. The standards can be set and the learning objectives can be measure. (Dennis, 2002)

Tyler's (1949) model is also known as "product" model and greatly influenced curriculum development in America (O'Neill, 2010). The product model has been considered valuable when developing and communicating outcomes to the student population and has moved emphasis away from lists of content. However, literature suggests that in using this model care should be taken not to be overly prescriptive when writing learning outcomes (Hussey & Smith, 2008). Doll (1993) criticizes Tyler's model for its linear ordering of the sequence: pre-set goals, selection, and direction of experiences, evaluation and its dichotomous separation of ends from means and the instrumentalist or

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functionalist view of the nature of education. Knight (2001) argues that writing program and/or module learning outcomes first is less effective than to first considering the aim of teaching/learning activities. Doll (1993) argues that Taylar's model is inconsistent with today's dynamic & complex educational requirements as the society is more open and diverse, multidimensional, fluid and more problematical.

We believe both Doll & Knight's ideas are equally applicable in the computing domain which is very dynamic and rapidly expanding in nature. The multi-dimensional usage of computing in conventional disciplines is giving birth to new disciplines. This dynamicity of the computing domain and the emerging needs of the rapidly changing society demand a generic curriculum development model which could be equally effective for the degree programs of both existing and newly emerging computing disciplines (ACM/IEEE-CS, 2012). To address this research problem, this paper has proposed a generic curriculum development model for computing degree programs. The structure of the paper is as follow. A historical review of computing discipline is given in Sec. 2. Various curriculum development models are discussed in Sec. 3. The proposed curriculum development model for computing degree programs is presented in Sec. 4. The concluding discussion and recommendations are given in the last section.

II. A Historical Perspective of Computing Disciplines

In early days, 'Computer Science' was used as a common term for computing. With the passage of time, the nature of basic principles, methods, techniques and concepts evolves. Even some new concepts refuted the old ones. For example, Hilbert's principle that formal mathematical theorems are provable by logical inference was questioned by Kurt Godel (1931) and Alonzo Church & Alan Turing (1936) that logic cannot completely prove all mathematical theorems. Similarly, many contradictory views of computing opened up new horizons for computing like the mathematical worldview (Davis, 1958) vs the interactive worldview (Goldin & Wegner, 2008), algorithmic programming (Hopcroft & Ullman, 1969) vs contemporary programming (Rice & Rice, 1969), etc.
Before 1990's, computing was limited to three disciplines – Computer Science (CS), Computer Engineering (CE), and Information Systems (ISs). By 1990s, the global community realized that the field of computing had grown in many dimensions. Different academic institutions started offering different degree programs in Software Engineering (SE). Consequently, the discipline of SE was added in the computing domain.

Most of us are witnessed the inventions of personal computers revolutionized the conventional concepts of calculation and changed the way data was stored, retrieved and controlled. Computers became essential tools at every level and networked computer systems became the information backbone of organizations (Kotkin, 2000). It also expedited the pace of inventions (Thomson, 2007) resulting many innovations in communication and computation technologies which brought a paradigm shift in the business world - from data processing to information processing; converting industrial society into an information society (Cohen, 2009). While this paradigm shift improved productivity, it also brought new challenges regarding the development, operation, maintenance, and up-gradation of organizational information management infrastructure (Samuelson, 1995).

By the end of 1990s, once again the academia realized that the existing computing degree programs were not producing graduates who had the right mix of knowledge and skills to meet organizational challenges (Lunt, et. al., 2005). Consequently, universities developed new degree programs in Information Technology (IT) to fill this crucial void (Denning, 2001); Hence IT was introduced as a new family member of computing disciplines (Lunt, et. al., 2005). The key characteristics of these five distinct but overlapping disciplines are discussed in Computing Curricula 2005 (ACM/IEEE-CS, 2005).

In recent years many significant developments have been made and many new concepts have been introduced like "Computational Lens" (Karp, 2011) which articulates a new relationship between computer science and other sciences, "ternary computing" dealing with computing for the masses (Li, 2010), "e-Science" Managing massive experimental data and collaborating via the Net, "Computational Thinking" (Wing, 2008), Cloud Computing (Li & Zhang, 2009), etc. Computing has also widespread usage ranging from regulation of protein production & metabolism, phase transitions in physical systems, strategic behavior of companies, regulating the mechanics of learning, managing the Web-based social networks, etc. In parallel, the integration of computing in other disciplines introduces new disciplines like "computational-x" (e.g., computational mathematics, computational physics, computational finance, etc.) and "x- informatics" (e.g., bio-informatics, dental-informatics, clinical-informatics, etc.). This dynamic nature of computing has made the curriculum development for degree programs a challenging task (ACM/IEEE, 2013).

III. Curriculum Development Models

Although the development of an effective curriculum has always been a topic of great concern in school education (Tyler, 1949; Taba, 1962; Wheeler, 1967; Walker,1971), many serious concerns from higher education made curriculum development an important research agenda for the higher education community. These concerns include lack of coherence, practicality, accessibility, quality, integrity, and over-burdened (HEC, 2012). In parallel, the business and industry leaders' concerns of inadequate skills of graduates (UNESCO, 2012) and citizens' concerns about graduates' disengagement from civic life (Kerr & Blenkinsop, 2005) further revels the shortcomings of the existing curriculum. Many deliberate attempts have been made to develop a curriculum model to increase academic rigor, sharpen students' critical thinking and analytical reasoning, and expose them to richer subject matter. Consequently, three main research strides emerge:

a) Instructional methods

In addition to conventional lectures and classroom discussions, many innovative instructional methods emerge in higher education like active learning, experiential learning, inquiry based learning, discovery based learning, problem-based learning, project-based learning; collaborative and cooperative learning, understanding by design, etc.

b) Evaluation & assessment

In addition to descriptive and multiple choice, new evaluation methods have been developed to promote Bloom's higher-order thinking and other competencies required in the employment market. New methods include self-assessments, students' portfolio, open book test, case studies analysis, group projects, prototyping, technology-based evaluation, etc.

c) Curriculum coherence & integration

The latest research brings many reforms in curriculum structure like integrating general education across the curriculum, integrating the disparate elements of students' learning experiences, shifting from curriculum objectives to attaining competencies, etc.

In addition to these aspects, some individual's work created a noticeable impact on curriculum theory. For example, in response to the increasing popularity of constructivist learning theory (Bruner, Goodnow, & Austin, 1956) and instructional design (Seels & Glasgow,1990) in higher educational practice, Biggs' (1996) put forwards a notion of constructive alignment. He adopted the idea of instructional design alignment from Cohen's (1987) who replaces learning with attainment (Biggs, 2002). Instructional alignment demands a precise match between what is intended to be taught, what is intended to be evaluated and what is intended to be learnt (Talbot, 2004). Whereas, constructive alignment asks for a shift from behaviorists' pedagogy to constructivist's pedagogy through stating the curriculum objectives in terms of the level of understanding required of a student than just listing the topics to be covered. Eisner (1991) model combines behavioral principles with aesthetic components to form a curriculum. His model is based on five core elements: intentional, structural, curriculum, pedagogical, and evaluative.

Over the last few years, new curriculum models in higher education have been developed to accommodate new means of delivery, access and storage of information and to incorporate more flexibility into the existing curriculum to provide better access to a wider range of students' body (Tinkler, et.al., 1996; Mitchell & Bluer, 1997). Bell & Lefoe (1998) talk about the selection of the media to be used for content delivery. Irlbeck et. al. (2006) "Three-Phase Design (3PD) Model" adopts a team-based approach to design, development, and delivery online courses. Their model allows designing a curriculum for online delivery. Some other models proposed in literature includes inclusive curriculum, Subject-Centered and Learner-Centered Models (McCombs & Whisler, 1997), spiral curriculum (Bruner, 1996), transformational curriculum (Parker, 2003), Project Based Learning, Standards Based Learning, Curriculum Mapping (Jacobs, 1997), Integrated Course Design (Fink, 2003), etc.

In this section we have discussed various curriculum development models. The literature reveals that no one model is ideal and no one model may suit to all disciplines. Natural sciences are different from the social sciences and require a different curriculum development approach. Computing is a rapidly evolving discipline and requires a more fluid & flexible model than Tyler's product model. Ornstein and Hunkins (2009) suggest that although curriculum development models are technically useful, they often overlook the human aspect such as the personal attitudes, feelings, values involved in curriculum making. In the next section we have proposed a process oriented generic curriculum development model for computing degree programs both in core computing disciplines and newly emerging fields such as "computational-x" and "x-informatics".

IV. The Proposed Curriculum Development Model for Computing Degree Program

In the proposed model curriculum development is defined as "a meta-process focuses on the constructing of a wide range of new processes or improving the existing ones to improve and support the curriculum development, execution and auditing activities to increase academic rigor, sharpen students' critical thinking and analytical reasoning, and expose them to richer subject matter."

The model defines the key processes involve in developing an effective curriculum for producing well-rounded computing graduates equipped with professional competencies ready to work in a more holistic way than simply demonstrating technical skills.

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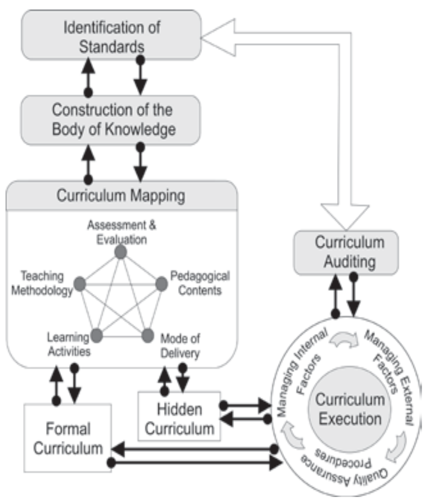
Figure 1 : Curriculum Model



The proposed model is based on following key principles. The curriculum

- Should be broadly based and interdisciplinary to accommodate the present and future needs;
- Should identify the fundamental knowledge areas that computing graduates must possess;
- Should provide a flexible structure to organize knowledge areas into courses for a variety of degree programs;
- Should allow institutions to integrate the concept of branding within the courses of study; and
- Provide students with the flexibility to work across many disciplines.

The model, shown in Figure1, has adopted a recursive approach for curriculum development and its implementation. Different processes are responsible of performing different tasks. Unfortunately, due to space limitations not all the related aspects could be discussed here. Only the key processes of the proposed model are briefed here.

a) Identification of Standards

This process is aimed to identify curriculum's objectives & students' learning standards aiming at the "future" trends, national needs, and the society's expectations about students' characteristics. Focusing on "future" is one of the key aspects differentiating this model from the existing ones. Also, the threshold standards are based on following six parameters; not only just knowledge and skills:

i. *Knowledge*

Theoretical learning of concepts and principles regarding a particular subject(s).

ii. *Skills*

Capability of using learnt knowledge and applying it according to the context.

iii. *Competencies*

An ability to do something satisfactory- not necessarily outstandingly or even well, but rather to a minimum level of acceptable performance.

iv. *Expertise*

Level of proficiency and innovative ways of applying the learnt knowledge. (Competitive edge)

v. *Dispositions*

Habits of mind or tendencies to respond to certain situations in certain ways.

vi. *Values*

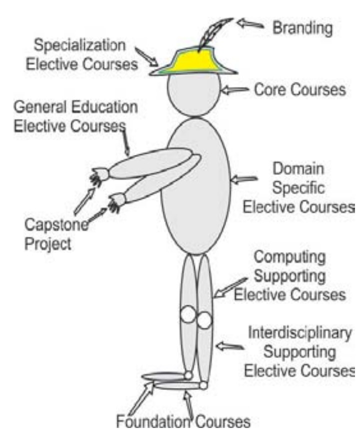
Moral, ethical and professional practices.

b) Construction of the Body of Knowledge

This process involves the identification & classification of knowledge areas and associated knowledge artifacts (contents).

c) Curriculum Mapping

Using the idea of Bigg's constructive alignment this process produces a semantic net of knowledge areas, pedagogical contents, teaching methodologies, mode of delivery, learning activities, and assessment & evaluation methodologies. The assessment & evaluation will address four aspects: i) students' achievement keeping in view their activities limitations and participation restrictions, ii) instructors' delivery & cooperation, iii) administration's support, and iv) effectiveness of curriculum processes.



The curriculum has two key components: i) formal curriculum, and ii) hidden curriculum. The formal curriculum comprises of following key areas:

- Foundation Elective Courses
- General Education Elective Courses
- Interdisciplinary Elective Courses
- Core Compulsory Courses
- Domain Specific Elective Courses
- Major Elective Courses
- Capstone Project

Figure 2 depicts the key idea behind the selection of these categories. The foundation, general education, and interdisciplinary electives deal with knowledge areas which build solid foundations for studying advanced computing concepts and workplace complexities. These electives could be from natural and applied sciences, social sciences, mathematics, humanities, and the disciplines of language and cognitive development, etc. The proposed model has suggested a small core encompassing the common knowledge areas of the existing computing curricula of different degree programs:

- Principles of Computing& Programming
- Principles of Operating Systems
- Principles of Database Systems
- Principles of Software Engineering
- Principles of Human Computer Interaction

Introducing common core in all degree programs may address many issues related to degree accreditation and quality education.

Hidden Curriculum is the second important component of the proposed model. It deals with elements like socialization, professional practices, desired dispositions, etc., which are embedded in the curriculum, the university and classroom life and is imparted to students through daily routines, curricular contents and social relationships, but is not a part of the formal curricular content.

d) Curriculum Execution

This process ensures the smooth delivery of the curriculum. It has three sub-processes: i) Managing external factors like contemporary life, technology, knowledge, ideology, economics, pressure groups, government policies, legal constrains, etc. ii) Managing internal factors like teachers, students, school environment, institutional policies and strategies, etc., and iii) Quality assurance procedure.

e) Curriculum Auditing

It involves the auditing of the curriculum taking into account aspects like, effectiveness, relevancy, acceptability, matching with national standards and accreditation recommendations, etc.

For meeting the emerging need of the dynamic nature of computing domain and the changing trends of the employment market, all processes are linked through a bi-directional inter-processes communication channel called fine-tuning and feedback channels. Both people and processes can generate fine-tuning and feedback messages to make positive changes in the curriculum. Similarly, all the processes and sub-processes can be tuned-up according to the emerging trends and needs of the market and society.

V. Conclusion & Recommendations

Although computing has become a mature discipline, high paces of knowledge exploration, invention of new technologies, and the emergence of new disciplines have introduced new challenges to curriculum development for computing degree programs. Presently, Tyler's (1949) product model is commonly followed in the development of curricula for computing degree programs. Many researchers have objected that product model fails to meet the needs of the today's dynamic & complex education as the society is more open and diverse, multidimensional, fluid and more problematical.

We live in the era of knowledge economies in which science and technology bonding has become stronger than ever before, continuing education and lifelong learning have got unprecedented importance, investment in intangible assets has become more valuable than investments in fixed capital, the relationship between knowledge, technology and innovation has become more important for economic growth and competitiveness (Utz, 2006). Although such activities all over the world are increasingly becoming knowledge oriented, but the degree of incorporation of knowledge and technology into economic activity is now so great that knowledge & technology have been recognized as the key drivers of productivity and economic growth (Kogut & Zander, 1992; Nonaka & Takeuchi, 1995; Choo & Bontis, 2002; Zítek & Klímová, 2011). The basic economic resource - the means of production - is no longer capital, neither natural resources, nor labor. It is and will be knowledge & the knowledge workers who possess high levels of education and/or expertise in a particular area, and who use their cognitive skills to engage in complex problem solving. Such knowledge workers will be the assets of the organization (Drucker, 2006).

Drucker (2006, p. 165) says, "It is generally accepted that the knowledge workers' expertise in their role is the starting point for enhancing both their individual and their contribution to the organization's productivity, quality and performance. If knowledge workers are to continue contributing to organizations and the economy at large, their knowledge must remain up-to-date." Davenport (2005) sees knowledge workers as people with high degrees of expertise, education, or experience and they are mainly involved in the creation, distribution, or application of knowledge.

Hence, transforming students into valuable knowledge workers able to work in future work places is one of the key purposes of the proposed curriculum development model. We believe the increased competition of the business world cannot just rely on graduates' knowledge and skills. Graduates' competencies, expertise and disposition will play a central role in gaining competitive edge in today's competitive world. Therefore the proposed model's learning standards are aiming to produce knowledge workers equipped with: up-to-date knowledge; marketable skills; valuable competencies; unique expertise; globally compatible dispositions; and

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culturally and professionally acceptable values Usually, standards are set according to existing practices. Time has come to adopt a proactive approach and standards should be set according to the future needs of both society and organizations. Through introducing competencies, expertise and dispositions among threshold standards we have given a new starting point for curriculum experts to extend the virtual boundaries of teaching-learning environment from classrooms to work-place environments. Usually, competencies and expertise are associated with experience. Time has come to rethink this concept. Today organizations need plug-n-play work force. Among a skilled programmer, a competent programmer, and an expert programmer, the organization will naturally go after an expert programmer. Similarly, being a programmer (disposition) is more valuable than having a programming skill or knowledge. Therefore, curriculum contents, teaching-learning activities and assessment and evaluation methodologies should be in line with market demands. Instructors need to move forward from pure academic contents' delivery to sharing of market oriented practical knowledge.

The model shown in Figure 2 depicts the key functions of the knowledge domains included in the curriculum. Time has come to realize the emerging challenges of forthcoming expansion of computing discipline. In place of adopting the conventional core curriculum approach the proposed model's flexible structure has unleashed the computing giant to demonstrate its potential in today's interdisciplinary world. The proposed model has a small core encompassing common areas of computing. This approach allows institutions to cater the needs of different computing degree programs and to offer the body of knowledge which is in line with the true spirit of the discipline and needs of the employment market.

It may be argued that the proposed model has eliminated the conventional core area like data structure and algorithms, data-communication, digital logic design and computer organization, etc. We believe these subjects have different standpoints in different disciplines. For example, low level programming is more useful for CE students as compare to IS students. To develop an appropriate mindset students' need to study appropriate contents and perform associated activities. These aspects could be covered under the category of 'Domain Specific Elective Courses'. Similarly, courses like discreet structures, data-communication, digital logic design and computer organization should be offered under 'Foundation Elective Courses'. Science, Mathematics, etc. should be covered under 'Interdisciplinary Elective Course'. Courses like Philosophy, sociology, the comparative study of religions, etc. should be taught under 'General Education Electives'.

The importance of Capstone project has already been realized in existing curricula. However, the proposed model has advocate for a composite approach towards the completion of the Capstone project. The students may work on smaller projects which can be integrated into a bigger project. Also, students can be encouraged to work in a collaborative environment. In this regard computing institutions can establish an online collaborative working environment through which students from different institutions can work together on a common project. These way students will learn about the current trend of distributed product development, outsourcing, etc. It will also allow institutions to share the available resources (structural, human, and technological) up to their maximum capacity.

Hidden Curriculum is an important aspect of the proposed model. Jackson(1968), who coined the term, argues that features like norms, values, dispositions, belief systems and social and behavioral expectations have little to do with educational goals, but are essential for students' satisfactory progression (Margolis, 2001). The proposed model suggests that life skills including desired dispositions, soft skills, public speaking, critical thinking & reasoning, ICT literacy, personal attributes, entrepreneurship, attitude towards lifelong learning, professional practices and other social skills should not be considered discrete items and should be threaded into the entire fabric of the curriculum and taught as a hidden curriculum through various elements of the education system. These elements include classrooms' social structure, teachers' exercise of authority, the rules governing teacher-student' relationship, teaching learning activities, and socio-cultural and structural barriers in the institution.

'Branding' is another important aspect addressed in the proposed model. Branding in higher education is a current topic among the academic community (Toma, 2005; Brunzel, 2007; Temple, 2006). Internationalization of higher education has further raised the importance of branding. To that end, Toma (2005) suggest that "branding" an institution in accordance with its cultural values and norms can help a university differentiate itself in an already crowded and competitive marketplace, whether that competition is for students, donors or public support. Working on these lines the proposed model allows institutions to develop their own brands through integrating branding features in the hidden curriculum or integrating special knowledge areas in the formal curriculum. The structure of the proposed model provides room for institutions to decorate it according to their needs. However, it is radically important that to have coherency and consistency in curriculum institutions & faculty also need to demonstrate it. If they curtail these aspects, then no matter who ever are teaching, the set target would easily be achieved.

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Data as a Service (Daas) in Cloud Computing [Data-As-A-Service in the Age of Data]

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Abstract - Data has become the enabling technology for many of the recent innovations. "More data trumps smarter algorithms" has been the mantra behind this revolution in computing. Given the rate at which the data is produced, there is need for scalable solutions to extract information out of them. Allowing the data to be stored in the cloud and be accessed without geographical and scalability limitations will remove many bottlenecks in bringing data-oriented innovations. Current cloud architecture solves the issues of accessibility and scalability, but poses several new challenges such as automatic management of the service, pricing the data, and security of the data. This talk will include several techniques to address these challenges using automatic physical design, service-based pricing, and cryptographic mechanisms. Data ➔ Information ➔ Knowledge ➔ Intelligence.

Keywords : *Daas, Aas, Mashups Eai, Cio's, Gs1, Crm, Silos And Loe.*

GJCST-B Classification: *C.2.4*

DATA AS A SERVICE DAAS IN CLOUD COMPUTING DATA-AS-A-SERVICE IN THE AGE OF DATA

Strictly as per the compliance and regulations of:

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Abstract - Data has become the enabling technology for many of the recent innovations. "More data trumps smarter algorithms" has been the mantra behind this revolution in computing. Given the rate at which the data is produced, there is need for scalable solutions to extract information out of them. Allowing the data to be stored in the cloud and be accessed without geographical and scalability limitations will remove many bottlenecks in bringing data-oriented innovations. Current cloud architecture solves the issues of accessibility and scalability, but poses several new challenges such as automatic management of the service, pricing the data, and security of the data. This talk will include several techniques to address these challenges using automatic physical design, service-based pricing, and cryptographic mechanisms. Data ➔ Information ➔ Knowledge ➔ Intelligence.

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I. Introduction

Data as a service, or DaaS, is a cousin of software as a service. Like all members of the "as a Service" (aaS) family, DaaS is based on the concept that the product, data in this case, can be provided on demand to the user regardless of geographic or organizational Separation of provider and consumer. Additionally, the emergence of service-oriented architecture (SOA) has rendered the actual platform on which the data resides also irrelevant. This development has enabled the recent emergence of the relatively new concept of DaaS.

Data provided as a service was at first primarily used in web mashups, but now is being increasingly employed both commercially and, less commonly, within organizations .Traditionally, most enterprises have used data stored in a self-contained repository, for which software was specifically developed to access and present the data in a human-readable form. One result of this paradigm is the bundling of both the data and the software needed to interpret it into a single package, sold as a consumer product. As the number of bundled software/data packages proliferated and required interaction among one another, another layer of interface was required. These interfaces, collectively known as enterprise application integration (EAI), often tended to encourage vendor lock-in, as it is generally easy to integrate applications that are built upon the same foundation technology.

The result of the combined software/data consumer package and required EAI middleware has been an increased amount of software for organizations to manage and maintain, simply for the use of particular data. In addition to routine maintenance costs, a cascading amount of software updates are required as the format of the data changes. The existence of this situation contributes to the attractiveness of DaaS to data consumers because it allows for the separation of data cost and usage from that of a specific software or platform. Store data on cloud and provide results on the data as service. We can generate an astounding amount data. More data → smarter algorithm. Solves intractable problems like Automatic driving, Machine Translation, Semantic search like Stone ➔ Bronze ➔Iron ➔Oil ➔Computer ➔ Data

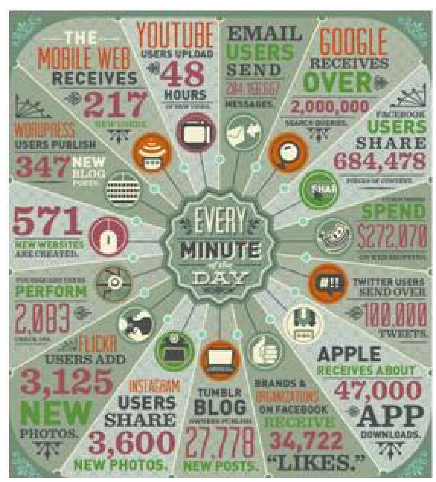

Figure 1 : Data disperse

As companies begin to decouple data from applications to enable richer services both internal and external to their organizations, new challenges arise that can both speed up as well as slow down adoption of data sharing using data-as-a-service offerings.

Recently Accenture formulate six predictions for game-changing technology trends. On the subject of the Industrial Data Services trend, it says that the **"freedom to share data will make data more valuable – but only if it's managed differently."**

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Figure 2 : Data sharing

Here these are eight dimensions of the value of data to an organization, which are difficult to measure in terms of actual prevalence, as follows:

1. Utility
2. Uniqueness or exclusivity
3. Ease of production
4. Usage and sharing restrictions
5. Usability and integration
6. Trustworthiness
7. Support
8. Consumer demand

The difficulty in shifting to an architecture that enables data as a service (DaaS) lies in a change in philosophy that CIOs have held for years. Who owns data? Is it the application, the application group, the organization, or …? To answer these questions, first consider the value of the data based on eight dimensions. However, to truly understand the value of DaaS and the shifting philosophy of data ownership to data stewardship, defining the data value chain is the first step.

II. Data Value Chain

The real value of data as a service can be measured by the length of the data value chain. When a company decouples data and makes it available for consumption as a service, they add value to the data value chain. The service can be used by the next "hop" to add value. The challenge is when consumers use the service to access the federated data and create their own isolated data pool silos. Currently, most data as services tend to look like a one-directional hub-and-spoke model.

Figure 3 : Data consumers request's/response model results in no data sharing

In this example, the data-as-a-service model is not being truly leveraged as a data value chain. Think of the example that Accenture gives where a company is grabbing data from its customer relationship management (CRM) system to study loyalty trends and, in the process, the marketing group creates its own isolated data pool, which is not usable by anyone else. What's even worse is if that data pool isn't constantly refreshed by the originating source. This model (Fig. 3) creates a break in the data value chain that causes data to quickly become old and inaccurate.

Alternatively, a healthy data value chain will have many consumers who may not continue the chain but won't store a snapshot view of the data they use. Instead, data will freely flow in and out of the core data sets as needed. The goal is to lay out the services in a way that produces a healthy ecosystem of data services along the value chain.

Figure 4 : Basic data value chain

Figure 4 shows the value of interweaving DaaS providers to increase the value of data and promote data reuse. The synergistic value comes when two or more services can feed each other value. This enables the ecosystem to grow the data value chain by way of enrichment between data consumers and data producers

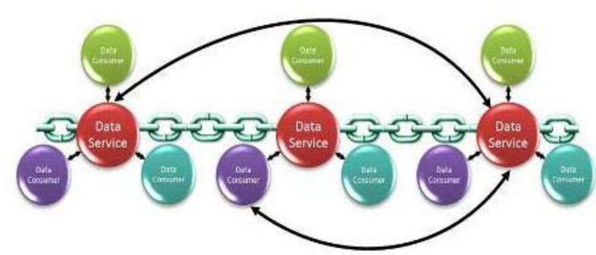

Figure 5 : Data value chain-added data enrichment

The challenge facing organizations is twofold:

1. To show the value in decoupling data from applications and
2. To create an open service-oriented architecture that allows the data to be shared both inside and outside of the organization.

III. Use Case Examples

Let's take a look at a couple of real examples of how a federated data-as-a service model can produce benefits not possible by traditional data management approaches.

a) Use Case 1: Secondary use of personal health data

An example of how setting data free can produce tangible benefits is illustrated by the sharing of health data via data-sharing services. The ability to decouple patient record data and aggregate it benefits medical facilities and practitioners by allowing them to:

- Monitor the health of the population
- Identify populations at high risk of disease
- Determine the effectiveness of treatment
- Quantify prognosis and survival
- Assess the usefulness of preventive strategies, diagnostic tests and screening programs
- Inform health policy through studies on cost-effectiveness
- Support administrative functions
- Monitor the adequacy of care.

Without decoupling and sharing the data via data services, these health benefits are extremely difficult, if not impossible, to achieve.

b) Use Case 2: GS1 Global Data Synchronization Network (GDSN) benefits to suppliers

GS1 allows suppliers, customers, manufacturers and producers to publish and synchronize product data into global data pools. Accenture and Capgemini have published reports describing the business benefits of GDSN based on extensive research with major associations, suppliers and retailers including Royal Ahold, The Coca-Cola Company, General Mills, The Hershey Company, The J.M. Smucker Company, Johnson & Johnson, Nestlé, PepsiCo, Procter & Gamble, Sara Lee, The Gillette Company, Unilever and Wegmans.

The results clearly show that synchronizing accurate and properly classified data brings many business benefits to suppliers. For example, time-to-shelf was reduced by an average of two to six weeks, order and item administration improved by 67 percent, and item data issues created during the sales process were reduced by an average of 25 to 55 percent (source: http://www.gs1.org/gdsn/ds/suppliers).

The business benefits include:

- Better category and promotion management
- Easier administrative data handling
- Smoother logistics
- Increased operational efficiencies
- Increased customer satisfaction
- Improved bottom line

IV. Challenges

a) Evaluate data silos – LOE and cost barriers

Not all applications can have data decoupled and shared. An organization has to survey its applications and data sources and identify those that can be decoupled and those that can't. The level of effort required to decouple data must also be weighed against the estimated value of doing it.

In many cases, the value of retiring the data store can be evaluated. For example, if a company loads in and statically stores tax tables, this can be painful to maintain and costly if the data gets stale. Even if the data can be decoupled and shared across multiple systems that can benefit from such access, the company may be better served by abandoning the data store altogether and subscribing to a data service that can provide tax table information in real time.

b) Privacy concerns

When an organization decides to share data to other applications and services outside of the current application or departmental walls — whether it is to other departments within the organization or to external organizations — privacy becomes a big concern.

Looking at our example related to the sharing of healthcare data for secondary use, the federal government passed the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rules to ensure patient privacy of shared data.

c) Security concerns

When a company decides to enable data services, security is another area of general concern. Who can access the data, and how? Limiting access implies access control, which needs to be managed. If the data is going to be exchanged, especially between networks, will it be secure, and if so, how?

In light of recent PCI DSS Level 2 compliance breaches (credit card data privacy), the movement of data and the risk of unwarranted access can be difficult to prevent without a solid security plan in place to protect the data and control access to that data.

d) Falling short of true value

In addition to the cost of making data available as a service, companies also need to evaluate the value of doing it by answering these questions: Will any other service or application benefit from the availability of the data in question? Does the decoupling of the data allow for an upgrade and retirement path for a legacy application? There are plenty of cases where the value simply isn't there, so the utility of free data needs to be carefully weighed.

e) Data governance

Publishing and subscribing to data services require data governance to ensure the accuracy of the information being shared. We must have confidence that the data we receive and the data we submit is validated and harmonized. For example, we trust that a page on Wikipedia is accurate because there's a process in place to ensure the information is verified and corrected to be accurate. Like Wikipedia, the data value chain has to have data governance built into it to ensure the data available for use is current, complete and accurate.

Therefore, individuals and organizations that participate in the data value chain as non-terminating links have the responsibility to be data stewards. A data steward maintains data quality by ensuring that data:

- Has clear and unambiguous data element definition
- Does not conflict with other data elements in the metadata registry (remove duplicates, overlaps, etc.)
- Has clear enumerated value definitions
- Is still being used (remove unused data elements)
- Is being used consistently in various computer systems
- Has adequate documentation on appropriate usage and notes
- Documents the origin and sources of authority on each metadata element.

While these practices are hard to enforce, the goal is to make sure that no single point in the chain is the authority on correctness, but rather that each link plays a role in ensuring that the data is good.

V. Benefits

Data as a Service brings the notion that data quality can happen in a centralized place, cleansing and enriching data and offering it to different systems, applications or users, irrespective of where they were in the organization or on the network. As such, Data as a Service solution provide the following advantages:

a) Agility

Customers can move quickly due to the simplicity of the data access and the fact that they don't need extensive knowledge of the underlying data. If customers require a slightly different data structure or has location specific requirements, the implementation is easy because the changes are minimal.

b) Cost-effectiveness

Providers can build the base with the data experts and outsource the presentation layer, which makes for very cost effective user interfaces and makes change requests at the presentation layer much more feasible.

c) Data quality

Access to the data is controlled through the data services, which tends to improve data quality because there is a single point for updates. Once those services are tested thoroughly, they only need to be regression tested if they remain unchanged for the next deployment.

VI. Requirements for DaaS

- Cloud-enabled elastic,
- scalable, high-performance
- No need for CapitalExpence
- All costs must be Operating Expence
- No infrastructure related decisions needed

a) Data must remain secure

- Not only in-wire, but also at-rest

b) Automatic Configuration of DaaS

- Deciding on starting/shutting down nodes – elasticity.
- Deciding when to build/tear-down indexes – user experience.

c) Automatically Securing the DaaS

- Transparent to the user/provider
- In-line encryption/decryption
- Maintain full key control

d) Why automatic configuration?

- Reduce admin overhead
- Cloud converts Capital Expence into Operating Expence

e) E.Data Storage Services

i. *Advantages:*

- Data fragmentation and dispersal
- Automated replication
- Provision of data zones (e.g. by country)
- Encryption at rest and in transit
- Automated data retention

VII. Conclusion

The drawbacks of data as a service are generally similar to those associated with any type of cloud computing, such as the reliance of the customer on the service provider's ability to avoid server downtime. Specific to the DaaS model, a common criticism is that when compared to traditional data delivery, the consumer is really just "renting" the data, *using* it to produce a graph, chart or map, or possibly perform analysis, but for data as a service, generally the data is not available for download."Service Automation Units" (code that expresses the service interface) may contain methods for all "CRUD" operations (Create, Read, Update, Delete), as in traditional data operations, but data as a service is generally limited to Read.

Before a true revolution in data as a service can occur, organizations must be convinced of the value. While value of an IT change is traditionally measured in ROI, the benefits of decoupling data from applications for sharing across the extended enterprise are far-reaching benefits that can't always be quantified by sheer financial savings or gains. "Put simply, increased sharing of data through data services calls for a radical rethinking of how IT should handle data management. Essentially, data management shifts from being an IT capability buried within application support to a collaborative effort that enables data to be used far beyond the applications that created it.”

Is your organization a link or a break in the data value chain?

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4. Manuscript’s Category,

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Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of 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 the 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 evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

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

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing 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 approach 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. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than 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 maintain the initial two items to no more than one ruling each.

- Reason of the study - 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 quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness 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 to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled 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 with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose 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 sound written Procedures segment allows a capable scientist to replacement 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 for the least amount of information that would permit another capable scientist to spare 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 object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text 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:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not 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 - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in 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 a 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. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise 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 in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to 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 part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a 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 implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly 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 with prospect, and let it drop at that.

- Make a decision if each premise is supported, 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 the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One 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 available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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

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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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