E-Marketplace for Cloud Services

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Abstract— **With the advent of Cloud Computing and the advantages it brings to businesses, there is a keen interest by businesses to adopt these technologies from a strategic advantage viewpoint. This growing interest throws up a challenge to businesses to identify solutions and providers that fits their requirements. It becomes difficult for them to locate and evaluate services provided by multiple Cloud Service Providers. This is exactly where the concept of an Electronic Marketplace for Cloud Services (EMPCS) would fit in. The Cloud Services Brokerage (CSB) or an intermediary is an enhanced type of EMPCS that simplifies the process further by a single-point, aggregated and customized solution. Using research literatures for reviewing existing models of an Electronic Marketplace (EMP) or Electronic Markets (EM) this research tries to identify core components that form part of a "state of the art" intermediary based EMP designed specifically for a Cloud Services.**

Keywords: cloud services marketplace, cloud service broker, cloud services marketplace reference model.

I. INTRODUCTION

Cloud Computing is rapidly changing the way IT services and products are offered. These services are currently evolving and will continue to evolve further with the ever-increasing services and type of products being offered by various cloud service providers. Enterprises are forced to rethink their strategies for building an IT infrastructure and cloud services are helping them by keeping things simple. Organizations can in a way outsource the hassle of building and maintaining their internal IT infrastructure to specialized cloud service providers. It is difficult to find a single source for the varying cloud service requirements of an enterprise. Many cloud service providers, serve very specific cloud areas (e.g. Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) etc.) or type of cloud and they vary a great deal in terms of their specifications, pricing and other detail models. One option is for the enterprises to deal with multiple cloud vendors and service providers. This fragmentation will lead to complexities in terms of integration, maintaining and consuming these services.

An important challenge will be in identifying various service providers who cater to specific needs and requirements of an enterprise [1]. One approach will be to identify providers from a directory or yellow pages catering to these kinds of services. Another approach will be the use of an E-Marketplace catering specifically to this kind of services. Generic EMP's like Amazon and Ebay, deal with a wide variety of products or physical goods. Making a deal on such marketplaces is generally as simple as searching, analyzing and buying. In some cases it is also possible to do some bidding or negotiations before you finalize a deal. An EMPCS works on the same line. Although a simple marketplace where Cloud Users and Cloud Vendors strike deals for Cloud Services still does not address issues related to the fragmentation of such services. Enterprises still have to deal with the integration and maintenance of such services in case of multiple vendors and providers. This brings in the need for an intermediary or broker who would further simplify the consumption of Cloud Services [2]. This kind of a technology partner for enterprises is called the Cloud Services Broker or the Cloud Services Brokerage (CSB). The CSB or an intermediary improves upon the idea of an EMPCS by providing a single-point, aggregated and customized solution and owns the responsibility of security, governance and quality of all the services provided. Early pioneers in the role of CSB's are Jamcracker [13], Parallels [19] and AppDirect [20]. Various researches carried out by Buyya [3] and Gartner Inc. [2], have highlighted some detailed and useful information related to the role and model for a CSB.

The focus within this paper is twofold, firstly to research existing models of EMP's and secondly to identify processes and components that are required to build a state of the art model for EMPCS from a CSB point of view.

The contribution of this research paper is to identify the key activities that go within a CSB and also a proposed modification to the "Reference Model for Electronic Markets" (RM-EM) by Schmid & Lindemann [6] to suit the needs of a CSB. The newly proposed modification is keeping in mind the transactional phases that occur within a CSB model.

Section II, gives an overview on the concept of an EMP. Section III, presents an overview of existing reference models in the same area. Section IV, describes the findings on models that detail the core processes and activities that are part of an EMP model. After describing briefly Cloud Services in Section V, keys difference between an EMP and

an EMPCS are described in Section IV. We also discuss our findings related to current CSB models in the same section. A proposal related to the suggested modifications in the RM-EM to suit a "state of the art" CSB model will be presented in Section VII. The paper concludes with Section VIII.

II. ELECTRONIC MARKETPLACE

An Electronic Marketplace or E-Marketplace (EMP) refers to an online market environment over the Internet where both sellers and buyers act as market players to exchange goods and services.

EMP's are broadly categorized into different types according to their ownerships or governance [1]. These types are:

a. *Private Marketplace* - owned by an individual company, which focus on connecting buyers and sellers to the marketplace.
b. *Public Marketplace* - described as a free marketplace or Business-to-Business (B2B), is often owned by third party organization.
c. *Consortia Marketplace* - created as a result of competitive companies from same industry and having same set of products and services.
d. *Community Marketplace* - owned by multiple participants with varied backgrounds.

There are three main functions of a marketplace:

a. *Matching of buyers and sellers* - This is the major function within a marketplace. The products have to be aggregated and their features, specifications detailed so it becomes easy for a buyer to search and compare the products according to his needs.
b. *Facilitate the exchange of information, goods, services, and associated payments* - Logistics, payment settlement, communication and tracking fall under this functionality.
c. *Providing an infrastructure that enables the efficient functioning of the market* - Following of legal laws, government rules and regulations to allow the smooth functioning of the marketplace is a feature of this functionality.

III. REFERENCE MODEL FOR AN E-MARKETPLACE

A Reference model is a framework for understanding significant relationships among the entities of some environment, and for the development of consistent standards or specifications supporting that environment. A reference model is based on a small number of unifying concepts and is an abstraction of the key concepts, their relationships, and their interfaces both to each other and to the external environment may be used as a basis for education and explaining standards to a non-specialist [5]. Further to this a reference model also forms the basis of designing specific models for actual implementation in reality.

The RM-EM defines three phases of a Market Transaction. They are depicted in Figure 1, and defined as follows:

a. Information Phase: is the phase of information gathering or evaluation phase of requirements and products from various sellers. It includes all analysis done to check the suitability of a product to a customers needs. The information phase lasts until products are chosen and an offer is received.
b. Agreement Phase: in this phase the conditions, pricing and other delivery related issues are negotiated. This phase ends with the signing of a legal contract between the customer and the supplier.
c. Settlement Phase: involves the delivery and payment of the final goods according to the agreement. Furthermore, it involves information about payment, logistics (transport, warehousing), Information Transmission, tracking and tracing.
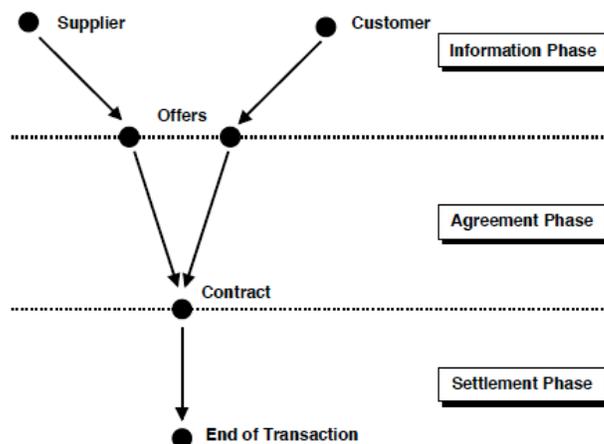

Figure 1: Phase Model of E-Market Transactions [6]

The existing RM-EM proposed by Schmid & Lindemann [6] consists of four layers and three phases. As shown in Figure 2, each layer represents a view for EMs. It consists of two dimensions. The horizontal dimension contains the three phases of market transactions, and the vertical dimension refers to the four layers or views (Business, Process, Transaction and Infrastructure). The upper two views represent the focus on organizational aspects and the two lower views represent the technological aspects of implementing such services.
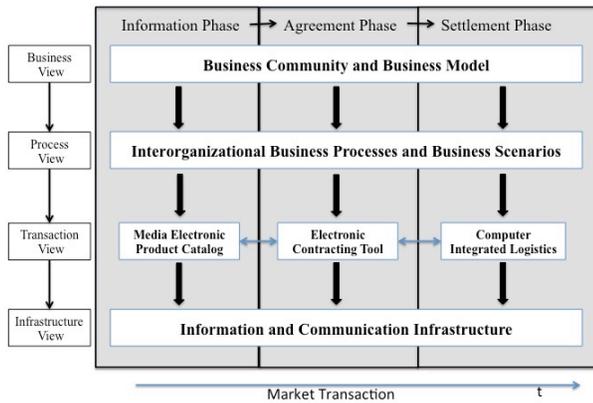
Figure 2: Reference Model for Electronic Markets [6]

Selz and Schubert [7] define a similar model, which goes on to add an additional phase after the Settlement Phase called the "Communication phase" to phases of an E-Commerce transaction.

IV.   MODEL FOR AN E-MARKETPLACE

Taking the RM-EM into account, we first look at the second layer in the model, i.e. the Process View, and we identify processes that are part of this view.

Before discussing models of a generic EMP, various activities or functions that are carried out within an EMP have to be explained.

An EMP system performs the following functions or services [8]:
- Organize the seller product Information
- Organize the buyer needs and preferences
- Facilitate commerce Transactions between the buyers and sellers
- Provide a flexible environment for multiple intermediaries to participate in the flow and monitoring of the commerce transactions.

Although there are many types of EMP's, and each type will have a set of activities associated with it, many of the activities are common across all the EMP's. These common activities can be classified as follows [9]:
- Content publishing tools
- Access management, authentication
- Bid/ask trading
- Auctions, on-sale
- Catalogs, Custom catalogs
- Parametric Search
- Product Configurators
- Aggregation

- Supplier Management
- Order Processing
- Invoicing
- EDI integration
- Event notification
- Fulfillment
- Business Rules facility
- Payment facility
- Workflow
- Reporting
- Integration to Back Office

A simplified list of processes (Marketing, Catalog Management, Order processing, Fulfillment and Settlement) form part of the model from Fingar, Kumar & Sharma [9]. There will be more functional processes required for running an EMP, but the above-defined processes form the core functions of an EMP. Figure 3 shows a graphical representation of an application framework for an EMP with above mentioned processes and their relation to external customers. Table 1 goes a step further and reveals various activities within these processes.
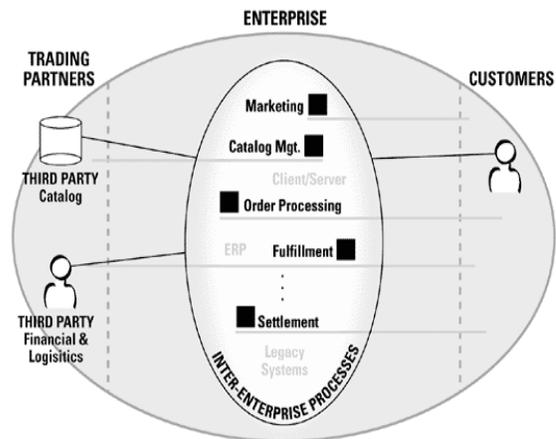

Figure 3: Processes within Electronic Markets [9]

1. Marketing: The Marketing process within an EMP involves all activities like identifying segments, products, building brand awareness and attracting customers. Defining target vendors and customers, promoting awareness; strategies for attracting new customers and customer retention are some functionalities, which play an important role in the marketing process of an EMP. A typical EMP has to identify the areas or specialized segments it prefers to work with, e.g. being clothing, sport, housing, electronics etc. A generic EMP caters to multiple fields and carries a larger number of products. The next stage is identifying and attracting the vendors or sellers who fit the segment description. Additionally, the process

involves identifying customers, segments, business or government agencies that would be interested in such field and attracting them to start using the EMP service. Advertising also forms a highly important activity within this process. As in a real world retailing market, building brand awareness and attracting customers is an important aspect with online markets. Furthermore, an EMP business has to analyze customer-buying behavior, industry trends and adapt its strategy accordingly. E.g. a customer who has recently bought a car from an automotive EMP will definitely be interested in accessories related to his car. A personalized marketing strategy that caters to existing customers and their recent buying behavior is definitely one of the activities that will stand out in a highly competitive industry. An intelligent system that predicts customer behavior will be an attractive prospect for a marketing process within an EMP.

2. Catalog Management: refers to the various aspects of aggregation of different products into a structured and consistent way. A new Vendor who is trying to sell his product through an EMP should have simple interface through which he can select product categories and features. For a customer who is trying to buy a product, it should be very simple to search and find a product according to his need. For segments with complex products and requirements, an ontology based approach for generating product classification is very useful. Shared and agreed ontology provides common, flexible, and extensible definitions of products and requirements for matchmaking and subsequent business processes [12].

3. Order Processing: in this process, users finalize a product that fits their requirement and then go on to order it. This process starts with the product being added into the shopping cart and is followed by functionalities like the customer authentication, gathering the billing and shipping information, calculating the cost involved in shipping and addition of taxes to the cost and more. Finally, the customer proceeds to confirm the order. If online, the billing methods are authenticated and an electronic receipt is sent to the customer via his email; additionally, the receipt can be retrieved via his account within the EMP. Also, part of the process is providing a feature for the customer to track his orders from within his account.

4. Fulfillment or Logistics: Right after the order is completed, it moves onto the fulfillment or logistics stage. It involves initiating the logistics related to packing and shipping a product to the customer. It starts with informing the external vendor of the order and shipping details. Once the order is shipped, the vendor updates the status into the EMP's system and it shows up within the customer account and can be tracked regularly.

5. Settlement: The settlement process involves clearing or settling of payments with the merchant banking if credit card transactions are involved. If other payment methods are involved for, e.g. payment on delivery, a receipt confirmation and updating of the payment status into the EMP system are activities that need to be performed. A major activity in this process will be also the settling of dues with the external vendors or supplier. This can be instant settlement once order is shipped or can be done at regular intervals, e.g., monthly or quarterly.

In addition to these processes some EMP models specify an additional process related to customer support, though, in the above model, this activity is included within the settlement process. More and more companies have a strong customer support service, which helps in building a reputation among existing customers. This in turn results in satisfied customers who use the services again.

TABLE 1: PROCESSES AND ACTIVITIES WITHIN ELECTRONIC MARKETPLACES [9]

PROCESS	ACTIVITIES
Marketing	▪ Merchandising ▪ Advertising ▪ Brand & Service Awareness ▪ Promotion Strategy ▪ Personalized Cross & up-selling ▪ Trend Tracking& Analysis
Catalog Management	▪ Ontology / Catalog Classification ▪ Content Publishing ▪ Catalog Management ▪ Catalog searching ▪ Availability checking ▪ Price and feature comparison ▪ Personalization
Order Processing	▪ Shopping Cart ▪ Approval and Authorization ▪ Inventory Update ▪ Tax and Cost Calculation ▪ Shipping Estimates. ▪ E-Receipts ▪ Order status/ tracking
Fulfillment	▪ Warehouse Integration ▪ Vendor Communication ▪ Packaging and Shipping ▪ Inventory Updating ▪ Reporting
Settlement	▪ Invoicing ▪ Payment Processing ▪ BackOffice Integration
Support	▪ Helpdesk ▪ Payment issue resolutions ▪ Returns

V.   CLOUD COMPUTING SERVICES

Cloud Computing or Cloud Services refers to a delivery mechanism through which on demand computing resources are delivered to end user terminals (Personal Computers, Mobiles, Tablets, etc.), generally over the internet. Cloud Services have some major characteristics or advantages that set them apart from the traditional form of computing. Firstly, the user pays by usage, secondly, it is scalable or elastic, i.e., users can upgrade a service anytime they require more resources and thirdly, it is completely hosted and managed by the Cloud Service Provider (CSP), i.e. the user only requires an internet connection and a computer to access the service. Cloud Services can be broadly classified in three major categories:

1. Software as a Service (SaaS)
2. Platform as a Service (PaaS)
3. Infrastructure as a Service (IaaS)

With technological advances more and more services are moving into the cloud and so the categories of cloud services have been expanding. New forms of emerging Cloud Services are *Database as a Service* (DBaaS), *Communication as a Service (CaaS), Network as a Service (NaaS), Gaming as a Service (GaaS)* etc. Most of these emerging forms of Cloud Services can however be broadly classified into the above-defined categories.

VI.   E-MARKETPLACE FOR CLOUD SERVICES AND CLOUD SERVICE BROKERAGE

Taking our research further from generic EMP's to specific EMP's tailored for Cloud Services or EMPCS, we identified existing models related to this segment.

Garg, Buyya, and Vecchiola [10] have proposed a design for a market exchange framework called "Mandi" which allows consumers and providers to trade computing resources according to their requirements. The primary aim of Mandi is to provide a marketplace where the consumer's resource requests and the provider's compute resources can be aggregated, and matched using different market models.

The main components defined in the Mandi architecture are:
1. User Services
    *   *Registration Service*: a user has to register before accessing the services of the exchange. The user details are stored in the database layer and are used for the purpose of authentication.
    *   *Authorization/ Authentication Service*: service to authenticate a user and provide him access to eligible services.
    *   *Resource Service*: allows a customer to search and find services that fit his requirement.

*   *Auction Service:* service required in case of bidding marketplace and allows the user to join in any auction and place his bid.
2. Core Services
    *   Meta-Broker Service: this service manages every single auction. It conducts the auction and all related activities.
    *   Database Service: storage service, which maintains all the information and stores data to every single activity within the system, e.g. product details, user details, user bids, auction details, winner details and more.
    *   Reservation Service: reserves the service and confirms to the service provider of the customers interest.
    *   Accounting Service: stores the trading information of the user, like bids, successful and failed.

Before going ahead in detailing the models for an EMPCS, some major differences between EMP's and EMPCS's will have to be explained. The one major difference is the type of products that are traded within these marketplaces. On one side through an EMP consumers buy or sell physical goods that will be shipped to us, while within EMPCS there are no physical goods. It is all virtual services that are bought and sold through an EMCPS. This reduces some activities like packing, shipping and logistics involved in delivering these goods. Another major factor of differentiation is that the services traded through EMPCS are not one-time deals. Rather, after buying of services, the services themselves need to be managed, maintained and updated by the trader or by the intermediary managing the EMPCS. So in a way it is long-term relation between the customer and the Services Provider. In case of a one time payment or deal based cloud product, there still has to be a support and other help provided to the user. Another major difference we identified through our research on this subject is that with such a new technology and multiple service providers, it is difficult for the customer to identify all the services he requires. Cloud Services requirement detailing, identification, discovery, integration and maintenance will always remain a major issue for customers due to non-standardized features, description and type of these services. This is exactly where the role of an intermediary or Cloud Services Brokerage (CSB) comes into play.

A CSB service gives the customer a solution for this exact problem with a single point, aggregated and personalized solution that fits well with the requirements of a customer needs. A Cloud Broker allows enterprises to put together services as required from a varied choice of service providers, platforms and cloud types. They also make it easier for the customer because they provide a simple and standardized single point interface.

Plummer et al. [17] define three types of CSB's:
1. Aggregation Brokerage: delivers multiple services to enterprises. No additional feature or functionality is provided from the brokerage. They simply aggregate and provide the services. Simple market places, App Stores, etc., fall under this category. GetApp [18], a cloud marketplace for SaaS applications, is a classic example of such a brokerage.
2. Integration Brokerage: this type of brokerages involves sourcing of varied type of services that are integrated at the broker's end and provided as a packaged service to the customers, enterprises or end-users.
3. Customization Brokerage: involves a personalized or customized integrated service, which adds or modifies functionalities or services to enhance its functionality. It also involves consulting and other services related to implementing the cloud strategy of an organization.
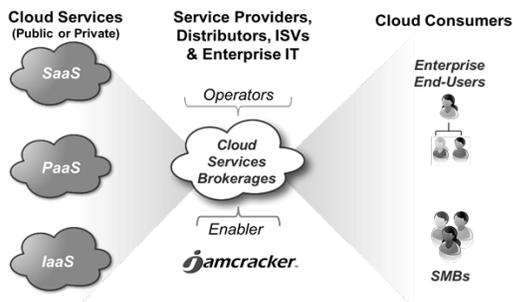

Figure 4: Cloud Services Broker Model [13]

By definition, a cloud broker is a third-party individual or business that acts as an intermediary between the purchaser of a cloud computing service and the sellers of that service. In general, a broker is someone who acts as an intermediary between two or more parties during negotiations. The CSB is an enhanced type of electronic marketplace for Cloud Services, which aggregate multiple service providers in a single location for customers to evaluate and buy Cloud Services. It also simplifies various other processes of maintaining, administration, billing and payment between external vendors and customers. Examples of CSB services are: *Jamcracker* [13] see also Figure 4*, Ensim* [14]*, Deutsche Börse Cloud Exchange* [15] etc.

To begin, processes that form part of such frameworks will be listed. Many of the existing models of CSB inherit processes from the earlier model of EMP as described. At a higher level, processes such as *Marketing, Catalog Management, Order Processing, and Fulfillment* (minus logistics) form an integral part of a model for EMPCS. Additional processes like *Self-Servicing, Services Administration, Billing, Metering & Chargeback and Support* are also important from a CSB viewpoint. Figure 5

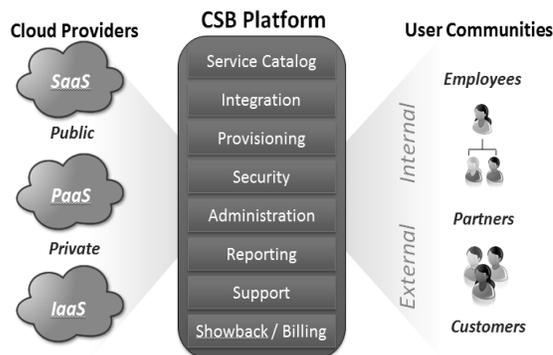provides a graphical view of the above-mentioned processes within a CSB platform.

Figure 5: Processes in a CSB platform [16]

The processes and features we discussed above are described in detail in an online article by A. Mauro [16]. Figure 6 provides a graphical representation of the workflow between these processes.

Service Catalog: this is similar to the catalog management feature in generic EMP's. It involves aggregation of content from external vendors or suppliers. This aggregated content is presented in a simplified format, which makes it easier for the customer to search, compare and finalize required services. An ontology-based approach is highly important here as Cloud Services vary in type and distribution so it becomes difficult to classify these Cloud Services into a single catalog. With such a new platform, there are very few standard classifications or ontologies to refer to and hence this presents a new area of research altogether.

Integration: all external Cloud Services have to be integrated into the CSB platform so it is easier for customers to request a service that combines multiple providers. It provides the user with a single point access to combined services as per their needs. Also, billing and administration of services can be centralized into one single console once integrated. From an IT implementation point of view, the Vendors have to add specific API's provided by CSB platforms for billing and administration into their Cloud Services

Provisioning: a central console for controlling services, and user provisioning is an integral part of this process. Also part of this process is the policy based automated provisioning.

Authentication and Authorization: Single Sign-On (SSO) uses a federated identity that provides access to all services with a single password. Roles-based authorization and access control provides granular control of cloud services access based on user role and privileges, password policy enforcement: enables uniform password policy across the enterprise

Administration: administration of users accessing the service is part of this process. All activities related to user management, like new users registration, existing user management, deletion, updating of user details come under this process.

Reporting**:** reporting, notification, and usage statistics are part of this process. Customers can access all these details form the Management Console of their account.

Support: general helpdesk activities including submission of tickets, FAQ, knowledgebase, notifications and alerts are part of this process. Additionally, for a first level support the customer can be assisted directly by the service provider.

Billing: all the billing procedures take place within this process. The customer can access all details regarding the services, usage, components and costs related to these services. This process should accommodate "Pay Per Usage" type of billing. All usage reports can also be accessed to view the billing calculation on the console. Payment and settlement services are also integrated into the platform for billing.

Figure 6: Workflow of a CSB Platform [13]

VII. PROPOSED REFERENCE MODEL OF A CLOUD SERVICES BROKERAGE

Through the research on the Cloud Services and related EMPCS, it becomes obvious that the basic difference between an EMP and an EMPCS is more related to the final phase from the phase model of transactions in Section III of this paper. In an EMP, the products that are sold or bought are physical products or services and mostly the transactions in such cases end with the final settlement phase. Once the product is delivered and the payment is completed the transaction ends. In case of an EMPCS, there are no physical products that are traded. Rather, these are virtual computing services. Also, in case of an EMPCS, the settlement or the final phase is not the end of the transaction. Rather, it is the beginning of business relationship between the customer and cloud service provider.

Hence, a modification of the RM-EM to suit a CSB service is proposed. According to our proposal, within the Reference Model for Electronic Marketplaces a Relationship Phase can replace the Settlement Phase. This Relationship Phase at the Transaction View includes a centralized console that is responsible for all activities related to service delivery, administration, maintenance

subscription, billing, management of the cloud service and support. The Relationship Phase continues as long as there is business relation between the customer and Service Provider. Figure 7 below describes the proposed changes.
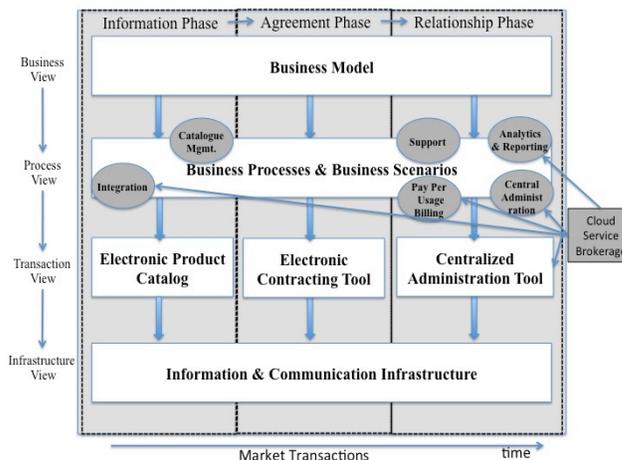

Figure 7: Proposed Reference Model for an EMPCS and CSB

Core activities within a "state of the art" CSB from our research findings are:
- Integration
- Catalogue Management
- Self Service & User Provisioning
- User Authentication and Administration
- Analytics & Reporting
- Billing – Including Pay per Usage.
- Support (Technical helpdesk & Generic support)

VIII. CONCLUSION

The current research findings have thrown some good insights into how a state of the art on Electronic Marketplace for Cloud Service should be modeled in real world. In general, many of the processes involved in a generic EMP are also part of an EMPCS model. However, to make an EMPCS or a CSB successful in the real world, activities like platform integration, centralized administration, maintenance, reporting, technical helpdesk, standardized billing also have to be included so that the user experience does not suffer because of the varied and complex Cloud Services available in the market. Most of these activities fall within the final phase, i.e. the Relationship Phase that replaces the Settlement Phase from RM-EM proposed by [6]. Some other major improvements we can suggest through our findings and analysis, are firstly, an ontology based approach for classifying the varied Cloud Services which gains a lot of importance within an EMPCS much more that a generic EMP. A standardized ontology for Cloud Services is definitely an important factor for organizations wanting to be successful as Cloud Service Brokers. Much more research is

needed into such an approach. Secondly, intelligent systems that simplify the matching of customer needs to available products and search suggestions, also will add a lot to such a service. In terms of performance, such a system could decrease the customer's service evaluation time compared to current EMPCS. Intelligent agents within such systems can also ease out the human intervention required during integration of new services into a CSB platform.

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