INFRASTRUCTURE FOR E-COMMERCE

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1. Introduction

The Internet and other new technologies (e.g. agent systems, mobile computing etc.) have created a number of interesting and innovative ways to deliver value to the customer while increasing the income potential of the merchant. Before the year 2000 it was estimated that the Internet connected more than 50 million users and 16 million servers in more than 140 countries and this number continues to increase exponentially. The electronic commerce sees similarly phenomenal growth. It is estimated that in 2005, 25-20% of World population will be regular customers of the Internet shops through which they will complete between 50 and 75% of all of their purchases [KASI02]. The Web, as a place for e-commerce, brings both advantages and challenges. While e-commerce has the same goal as any other form of commerce, to maximize the amount of sold commodities and thus the generated income, it differs from it in many respects. (1) While the conventional stores carry only a limited supply of (typically most popular) items, e-shops can offer an almost unlimited number of items, including specialty products targeted for only relatively few customers. In particular, agglomerations of e-merchants (e.g. www.totu.pl, www.amazon.com), acting as intermediaries between sellers and customers generate a very large commodity search space (e.g. [MABA00], [VALE01]). This allows customers to comparison-shop and select their favorite brand without leaving their chairs. (2) By the same token, traditional store can reach mainly customers who live in the neighborhood, whereas the e-store makes it possible to pursue global sales. In addition, keeping a physical store open 24 hours a day is rather expensive (with nightly operation generating only minimal income), while the computer system supporting e-commerce can run non-stop with almost no overhead. These features generate a potential advantage for the e-merchants: (3) while the traditional commerce is limited by time and space, the Internet commerce is characterized by an almost unlimited availability. (4) An additional benefit of e-commerce is that it allows the seller a natural opportunity to gather information about the behavioral patterns of visiting customers (including their transaction records). There is a number of ways that such an information can be applied: (a) to better meet individual customer

expectations (resulting in the increased number of transactions and thus in increased profits), (b) to study the behavior of the entire client population (mining knowledge that can be then fed-back to the e-commerce support systems), (c) to study the current market trends (e.g. to assure that fashionable commodities are available to the clients), (d) to exchange information with (to sell it to) other businesses[1] (as a source of additional information applicable in own system and/or source of additional income). The e-commerce system brings also about some challenges. (5) While it is relatively easy to gather information, its amount may lead to an information overload[2]. It is only "processed" information that can be useful to the user (merchant). (6) When considering the case of an e-store, we notice a small paradox, which needs to be appropriately addressed. On the one hand, it is easy to provide the potential customer with more information about product(s) and service(s) that we try to sell (and large amount of such information is also available in a multitude of additional, Internet based, repositories). On the other hand, e-stores have to convince the customer to shop without the support of a human (and without a physical contact with the merchandise)[3]. Therefore, it is important to develop an environment such that when buyers make their purchasing decisions, they can feel like being in a traditional small store.

In response to these opportunities and challenges, the development of successful e-commerce initiatives requires creation of an appropriate infrastructure that will support the required functionality. Such an infrastructure has to play two major roles. On one hand, it should help the customer to purchase goods in the time frame in the way that he/she is inclined to do it. On the other hand, it should help the merchant to maximize the total number of purchases completed by her e-business, thus increasing her income. This infrastructure should provide assistance by dealing with the vastness of the search space and offering recommendations based on the knowledge of individual customers acquired, among others, through analysis of their earlier/other purchases. More precisely, the Internet allows merchants to communicate directly and individually with buyers (marketing based on full

[1] While we acknowledge that the privacy of data is one of the more important issues in e-commerce, we assume where that this issue can be successfully solved. For instance, only the global trend data (e.g. product and service association rules for the expert system) are shared/sold, while the personal identity of individual clients is kept secret.

[2] Here, the information originates from within the system e.g. information about customer behavior, as well from outside of the system e.g. information about the suppliers, commodities and trends as well as events. While each of these information sources can effect the success of the e-commerce system, managing all of them becomes a real challenge.

[3] In Section 2 we discuss the distinction between physical and virtual goods that can be sold in an e-commerce system. Here, we assume that there is a class of products for which physical contact with is considered an important part of buying experience.

utilization of customer profiling) and in the future it will be the successful development of individual links with customers that will decide the e-enterprise' success. Observe here that since the e-commerce is based on a number of one-to-one relations, the structure of merchant goals and expectations has changed. Instead of maximizing the number of customers to which a given product is sold, the goal of the system is to maximize the number of products sold, over an extended time, to each individual customer. This is the marketing concept in it's finest: giving individual consumer exactly what they want, at the right time and place while meeting a firm's profit objectives. It will be companies that develop an appropriate infrastructure, providing them with timely access to the necessary information to support this business model that will be able to realize higher profits (and survive the competition).

While there exist a number of attempts at analyzing e-commerce, there do not seem to exist too many comprehensive solutions. In addition, most of these attempts concentrate on the functionalities that support the client side of the relationship (omitting the needs of the merchant). This paper has two goals. First, to present an overall infrastructure of an e-commerce endeavor. Second, to discuss the required functionalities to satisfy the client and support the merchant. While pursuing this goal, we have to make it clear, that we are approaching this problem form the merchants' perspective (the ultimate goal of the system being profit maximization). Here, the maximization of profits is achieved through the satisfaction of clients needs, and in this way increasing the likelihood of client' purchasing goods.

We proceed as follows. In the next section we summarize some of the most important aspects of e-commerce. Section 3 contains the discussion of the client and supply subsystems. The proposition of the e-commerce infrastructure we present in section 4. We complete the presentation with the future research directions.

2. E-commerce

To achieve its full potential, e-commerce requires the development of an appropriate support infrastructure. It can be said that currently its creation involves more challenges and unsolved problems than answers and ready-to-use solutions. Short time of existence of e-commerce, and an extremely fast pace of its change result in lack of in-depth self-assessment and scientific studies (especially studies that would analyze developing trends and view e-commerce from a historical perspective). As a consequence, ad-hoc solutions based on intuitions and experiences gathered in traditional businesses are applied. It can be even hypothesized that these are at least some of the reasons for the collapse of the dot.com industry in 2001. To contribute to the development of a more complete

picture of e-commerce related issues, let us try to clarify at least a few points. We will then try to show, that regardless of the details, the same overall e-commerce support infrastructure is required in each case.

There exist a number of factors that need to be considered when dealing with the e-commerce support/development. First, we should consider the web-business model, and here at least three basic situations need to be taken into account:

(1) Pure-play web model, where the e-commerce portal becomes only an intermediary ([MABA00], [VALE01]) between the sellers and the buyers, while carrying no inventory of its own, it depends on outside commodity providers to deliver products and services to the customer. While this model does not seem to be gaining much momentum recently (pure-play stores were among hardest hit in 2001 and they are still trying to recover), we believe that this model may have a successful future. Currently existing examples of successful enterprises of this type would be primarily in the services sector, e.g. Internet travel agencies (www.travelocity.com, www.travelzoo.com, www.orbitz.com etc.). However, some activities of Amazon.com (merchandise provided by a very large number of independent resellers working under Amazon's umbrella) also belong to this category.

(2) E-commerce portals combined with their own delivery systems, which can be considered a counterpart to the standard store-chains, except that points of sale exist only on the Web. Here, the most typical example would be the original set of activities set forward by Amazon.com (e.g. books, CD's, DVD's etc.). More, generally, Internet-bookstores and music stores often operate in this mode (e.g. merlin.com.pl).

(3) Click-an-mortar business model, where the e-commerce presence is developed as an extension to the physical store(-chain) presence. Currently this model seems to be relatively most successful as it naturally solves a number of problems faced by other models (e.g. return of merchandise, flow of cash to support its activities, etc.). Typical examples would be, e-presence of Wal-Mart retailing chain (www.walmart.com), or that of the Barnes and Noble bookstore chain (www.barnesandnoble.com).

Second, one should consider the type of merchandise that is being offered. As indicated in note 3, above, one can distinguish between physical and virtual commodities (which parallels the distinction between goods and services) and this distinction has specific consequences for the e-commerce system. (i) For physically existing goods (e.g. stereo equipment, cloths, silverware etc.) the direct contact with the merchandise is typically considered a part of the purchasing process. This fact becomes an important problem that has to be overcome by the e-commerce systems. (ii) In case of virtual goods (e.g. tickets for sporting events), no physical contact with the merchandise is required to complete the purchase. Here, an

addition of the Internet based information is a value-added service for the customer and can be used to the advantage of the merchant. (iii) Interesting is the case of "intermediate" goods (e.g. books and CD's), where the contact with the merchandise is not "required," but many customers are still used to the browsing experience as an important part of the selection and purchase process.

Third, one should consider the information that will be made available to the user of the e-commerce system and its role in the business model. Here we can distinguish three categories:

(a) The direct sales-related advertising (based on the user profile). The system displays the advertisements of the products, which the user is likely to buy (e.g. in the case of a bookstore, the information about the books that the system believes the user may be interested in buying are displayed). This information is expected to result in a product sale.

(b) The „indirect" advertising. Here we display the information that may be of interest to the user (again, based on the user profile), but does not lead to sales by our system (e.g. in the case of the internet flower shop, we may display the advertisements of the jewelry store; here, we do not have an agreement to sell their jewelry directly, but that we have a contract to display their advertising). While this information does not result in sales of "our" products, it leads to income generation, through the advertising revenue.

(c) The "value-added" information that is being made available to the user to make our site more interesting. In this way we attempt to attract the attention of the user, to make her come back and thus increase the potential of selling more products (e.g. in case of a vine selling site, a newsletter is posted providing information about the best vines from a given year as well as vine facts and history).

Finally, one can look into the sources of income, as related to the personal information flow in-and-out of the system, that are available in the e-commerce environment. Here we can consider at least three situations (each one characterized by a more elaborate information sharing and/or delivery):

(A) Closed system, where only the products and/or services and the advertising related to the sold products is presented (very limited amount of information of type (b) will be displayed). A typical example would be a vinery, where only its vines are being offered. It is however possible, that vine tours offered by a local travel agency, that include vine tasting in this vinery may be also advertised. In this model all customer data is being kept by the system for the internal use.

(B) Information and advertising sharing model. Here, the infomediary system delivers information and advertisements about any number of available products (it is also possible that all products sold come from the outside sources). This model is very similar to traditional stores that display advertising of products sold there. The only restriction is that all personal data, and all data derived out of collected customer information are being kept by the system for internal use.

(C) The open information model is an extension to the (ii) above. Here, the access to the customer information is opened to the outside partners (e.g. for a price). Here, the small local store can obtain access to the personalized user profile and use the available information to sell its products/services (e.g. a railroad station bookstore can use the personal information about the use reading habits, to facilitate book-selling in the environment where time is of utmost importance). In this model, any knowledge, extracted form the personal data, is available for sale and/or barter.

Let us note that the above-described categories are in many ways independent and can be combined in various detailed e-business models (e.g. a closed system, dealing with physical merchandise, based only on private advertising information combined with the value-added information for the click-and-mortar e-store, or an open information model, selling virtual merchandise, combined with the delivery of all three types of information for the pure-play Web-store). A detailed study of possible combinations and their detailed business models is, however, outside the scope of current paper. We should stress that, regardless of the detailed e-business model used, the e-commerce support infrastructure is very similar. The aim of this paper is to discuss various functionalities that are required in a generalized e-commerce support system. Before we proceed let us note, that while most of our work is naturally extendable to the business-to-business e-commerce scenario, we will focus our consideration on the business-to-client model.

Most of the discussion presented above indicates clearly that an e-commerce system consists of three parts: (i) the customer subsystem, (ii) the supply subsystem and (iii) the communication that connects them. We have illustrated this model in Figure 1. Each of these subsystems consists of a number of functionalities. The remaining parts of this paper are devoted to a detailed description of each of them.

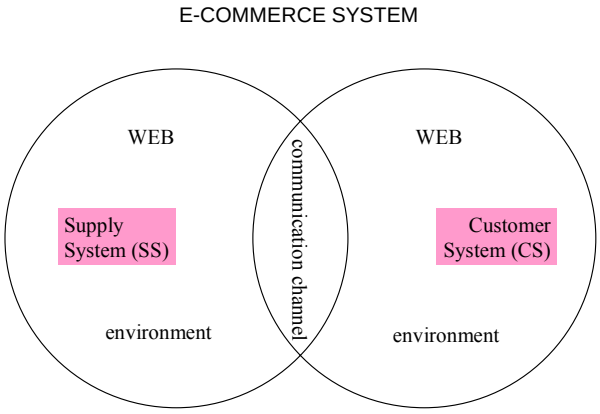

Figure1. Two main subsystems of the e-commerce system and their common communicate and exchange part.

3. E-commerce System (ES)

The e-commerce system can be described in a number of ways. We have decided to proceed with the functional decomposition first, as it gives us a natural way of presenting the highest level of abstraction of the system design. At this level of detail we have combined some more specific functions into joint units, which will have to be concretized during the system development process. The summary of the system functional decomposition is presented in Figure 2 (all of the references in the form “block n” below refer to this figure). We will proceed first, to describe the customer part of the system and follow with the description of the sales-and-supply-related functionalities. Finally, in the next section, we discuss the e-commerce infrastructure necessary to support it.

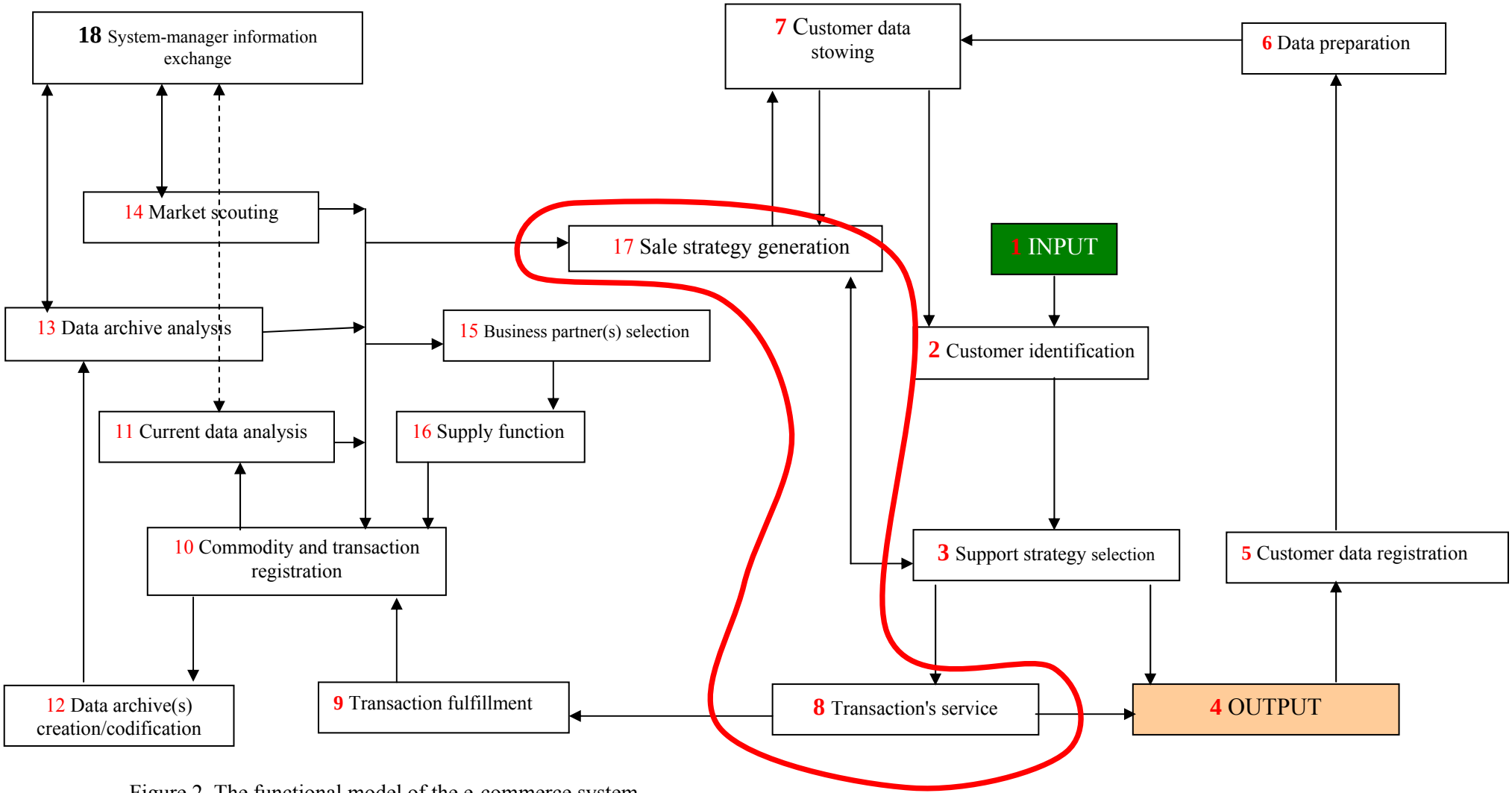

Figure 2. The functional model of the e-commerce system.

3.1. Customer System (CS)

The explosive growth of variety of commodities available both on and off the Web is staggering. The personalized support of the search process gives the client the ability to keep pace with appearances of new interesting products and thereby it should help increase the volume of commodities sold through our e-commerce site (we need to remind that in our considerations we represent the merchant point of view and thus the increase of sales is one of the important goals of the presented system). The main goal of the Customer System (CS) is to interest the client in the available offers. As suggested in the Introduction, the basis of the proposed approach is one-to-one marketing. The functional decomposition of the CS side of the ES system includes blocks 1-7, as well as blocks 8 and 17, which are shared with the supply system (SS).

The **input** (block 1) represents the entrance to the system, where the **customer identification** (block 2) takes place. There are three groups of customers: (A) first time visitors, who are not known to the system, (B) those, who have visited it in the past, but didn't register, and (C) regular clients. For the new customers (categories (A) and (B)), our system will create the initial customer profile by applying strategies described in [GAPA] (this is also a part of the **customer identification** functionality). For each client (returning, or one for whom the profile was just created) the system determines the appropriate support client strategy (**support strategy selection**, block 3). The strategy is adjusted to the individual customer (content personalization). These functions can be performed by the agent technology. We assume that a personal agent will be assigned to and assist the customer throughout all his interactions with the system. The **personal agent** should match the customer needs (pointing him to the commodities that match his interests), resulting in increase of the sale volume. In addition, our system should be capable of tracking user behavior and automatically adjusting their profiles (see also [GAPA], [AGPA], [SPFA]).

There are three possible outcomes of customers' interaction with the system. (i) There was no transaction. (ii) Customer decides to complete the purchase and appropriate information about it is passed to the **transaction service** (block 8, see also see Section 3.2). (iii) Session results in multiple transactions (the ultimate goal of the system). In each case the **personal agent** collects full information about the session. Upon finishing the interaction (**OUTPUT**, block 4) the **personal agent** passes the session log to the **customer data registration** function (block 5). This information is stored in temporary **user behavior database** and, in the next step, it is processed by the **data preparation** function (block 6). Here, in order to remove the incomplete, conflicting and redundant records, data has to be filtered. Additionally, filtering allows us to select for storage only information that will be useful for the e-commerce support system. This pre-selected information will be used to modify the content of the **customer database** as a part of the **customer data stowing** function (block 7). Note that in our system data describing customer behavior is kept in two repositories, the **customer database** contains the information about the current customer behavior, while the **warehouse** stores all historical data (see also Section 3.2). Therefore, the rules for archiving of data (moving it to the warehouse) need to be specified [GEN02].

3.2 The supply system (SS)

The supply system (SS) encompasses all functionalities that are necessary for the merchant to be able to fulfill the customer requests. Technically, the supply support is not a trivial task and one of the important reasons is that it currently involves dealing with both web and non-web based suppliers (not all producers utilize access to the web, as many still operate in the traditional way). We have to assume that such a situation is going to last for some time. Let us, however, assume that the technical problems of communicating with suppliers have been

solved. We will now follow the functional flow of the supply system as depicted in Figure 2 (blocks 6-16 as well as blocks 8 and 17 shared with the CS).

Continuing to trace the customer interactions with the system we have already reached the **transaction service** function (block 8). This function consists of a large number of subtasks, which include: payment processing support, assurance of transaction security, searching for the best way to deliver ordered commodities (for example, to find the closest location taking into consideration other specific requests, e.g. delivery after 5PM, pink wrapper, personalized message etc.), sending the prepared and confirmed order to be fulfilled. We also have to take into consideration the "customer service" to handle the returned goods (the way in which this procedure takes place will vary between the three e-commerce models introduced in Section 2). Therefore, we need to store all information about customers and transactions for an established period of time, after which we can close and confirm the registered transaction data. Data generated by this function influences both information about customers and about commodities (returned goods have to be reflected in the **customer data stowing,** block 7, and in **commodity and transaction registration,** block 10). Transaction service influences the SS by changing the state of commodities thus joining the two parts of the ES.

The last action that completes the transaction process is **transaction fulfillment** (block 9). It deals with the delivery orders that are registered and changes the information about the commodities. We can treat this function as just the output of the **transaction service** (block 8), thus these two functions (block 8 and 9) are joined in **transaction module** (see Section 3.3). Observe that in the case of e-commerce model (1) – pure play e-commerce – only the information about the commodities sold is necessary (as no factual commodities are stored by the infomediary). In case of e-commerce models (2) and (3), this function has to be additionally integrated with the commodity management as each transaction changes the number of items available in the physically existing warehouses. This leads us to the core of the e-commerce infrastructure system – the **commodity and transaction registration** function (block 10), which involves storing all indispensable information about commodities, transactions and suppliers (virtual or physical). This information will be stored in the **commodity database**.

One of the more important points of the system is development of the best usage for the information stored in the **commodity** and **customer databases**. This will be achieved by correct preparation of data analysis. Here, we distinguish two types of data: current and historical[4]. This leads us to the next function of the system, **data archives creation and modification** (block 12). As the time passes, data describing transactions, commodities and customers becomes "historical" (see also Section 3.1) and is moved to the **data warehouse** (based on the principles governing transfer of historical data).

Since our data is divided between current and historical, our system requires two data analysis modules. First, the **current data analysis** function (block 11) containing standard tools to analyze the collected information about products, transactions. System manager should establish schedule of generating reports, their types, ranges and structures. Such arrangements depend on the e-commerce model and properties of the environment the system works in. This functionality is achieved via the **system-manager information exchange** (block 18). We suggest using properties of active database environment to automatically invoke **data analysis modules**. The **current data analysis module** would be invoked when a certain set of conditions would be satisfied (e.g. at the end of each day systems involving warehousing of physical commodities would run analysis of completed sales and use it to replenish goods that have been almost sold-out). The main goal for this function is on-line monitoring the state of the databases to increase the speed of the reaction to important events. There are a number of

[4] While these four databases (current and historical; transactions and customer) can be implemented as separate tables in a large single database (i.e. an integrated enterprise data solution offered by IBM or Oracle), for the purpose of this paper we will treat them as functionally separate units. The reason is twofold. First, they participate in different types of data analysis. Second, such separation may lead to an improved system performance.

features of the customer behavior that are crucial to successful functioning of an e-commerce site. Let us list just a few. For commodities that are being offered by the system, we would like to know which ones are a "success" and which are a "failure" (where the definition of success and failure is relative to the application). For the information delivered by the system (in all three information categories) we would like to know which information is being accessed and which is being ignored.

The system also includes an **archive data analysis function** (block 13) connected to the **data warehouse**, where the historical commodity and transaction data, as well as customer behavior data are stored. While both data analysis modules work in a similar way, their goals are somewhat different. The "short-term" analysis is used to recover the most recent trends, while the mining of the data warehouse is aimed at obtaining a more global picture of the customers and their behavior. In this way, the most recent trends are investigated "immediately" and used for the direct interactions with the customers. At the same time, data mining can take place when the system is less utilized and should be considered a low-priority activity (this is particularly the case since large-scale data mining is a time consuming activity, e.g. the data warehouse analysis runs only at night and its completion can take multiple nights). We can assume here that the state of the data warehouse is "frozen" when the analysis process is initiated (no new data from the transaction and customer databases is added), and only after its completion its content will be updated. A typical example of important data mining activity is the verification and fine-tuning of user clustering. One-to-one marketing, which is the centerpiece of our business model, depends on high accuracy of user profiles. Since development of an individual user profile takes time, in many situations we have to rely on user clustering. For instance, user clusters will be used to help generate initial user profiles for these users who do not want to provide extensive personal information. It will be also used by the advertising delivery expert system etc. (see also [GAPA]). This being the case, we should strive to constantly try to improve the accuracy of user clusters recognized by the system. To achieve this goal we can utilize real-life data about the user behavior and apply one of many cluster-update techniques (e.g. [RUD01], [KAHK99]). We can also assume that over time we will be able to run a complete re-clustering of user profiles, based on the real-life data collected by the system.

We have to stress here that in the proposed system setup, we assume that one of our goals is to run all of the available hardware non-stop at almost 100% CPU utilization. This assumption is similar to the way that some of the distributed computing projects work (e.g. seti@home project, grid projects etc.). Here, we can afford the computationally intensive operations as we make an assumption that most of the time there will be some spare CPU capacity left in the system. Since the results are not immediately required and necessary for the successful operation of the system, they will be computed continuously and delivered to the system as they become available.

Market scouting is one of the important functionalities readily available in an e-commerce system (block 14). Its main role is to influence the direction of e-business strategy development. Market monitoring is the key that should make e-business activity secure in a long run. The proposed **markets scouting module** should be based on the agent technology with the range of monitoring tasks and the necessary contact with the manager. There are two types of decisions that the market scouting may result in. Lower level actions should be allowed to be taken up by the system itself (active function) while others have to be send to system manager(s) (passive function). The managerial control/decision making is forced since the crucial decisions about the business direction cannot be left to (even most intelligent) autonomous agents. As a result there appears the need to create the **system-manager exchange module** as the base of the **system-manager exchange function** (block 18). This function interfaces the manager(s) with the results of long and short-term data analysis as well as the results of market scouting and allows managers to undertake appropriate actions. The system manager then decides what to do in the occurring situation. The decisions concern such

functions as sale strategy generation, business partner selection and, indirectly, supply and/or commodity management. We need to accomplish this function by designing an appropriate interface to make possible the information exchange function.

One of the actions the system that requires full data analysis is the **business partner selection** function (block 15) that involves the possibility of making selection of commodity suppliers or, in general, business partners. The analysis delivers the sufficient information to make appropriate supply-related (resource distribution) decisions, including preparing the offer list for the commodity acquisition. On the basis of this analysis (which may include clients' opinions and comments) it is possible to make best possible choices, which also include commodity properties and prices. Prepared offer is the base for the commodity purchase negotiations. Commodity purchase should automatically modify the information about the commodities in the purchase documentation database (a part of the commodity database). It may be done by active or passive software ([SCGM01]).

The next action that can be taken on the base of the completed analysis is the **sale strategy generation** function (block 17). It involves the complete data analysis (transaction, customer, goods, and markets scouting). For example a sale promotion can be initiated based on the results of the current data analysis. At the same time this promotion may be also used as a one-to-one marketing strategy, by being offered only to selected customers. Similarly, results of data analysis may imply the necessity to modify or to create new sale strategies, i.e. if some commodities linger in the store they need to be sold through a promotion or a clearance sale. New sale strategy can be recommended on the bases markets scouting analysis, for example new fashion trends imply advertisement for new goods (also taking into consideration individual properties of customers). The created set of sale strategies needs to employ **expert system technology**. The sale strategies are the rules that specify the e-commerce politics. They are created on the base of goods we are dealing with, analysis and knowledge of the customer.

There are two types of information infrastructure for the CS originating from the SS. The first, as mentioned above, is a participation in employing the appropriate sale strategy. The second is the creation and maintenance of the advertisement set, which is used by the CS to encourage the customer to buy additional products. Advertisements are adapted to state of the store, to the newly purchased goods, to the sale policies and guidelines and to the individual requirements (here the advertisement personalization comes to play, as described for instance in [GAPA]).

On the end of describing the e-commerce support system functionality we have to pay some attention to the two joined functions in Figure 2. There are: **sale strategy generation** (block 17) and **transaction service** (block 8). The first functions create the transition from the SS to the CS and the second establishes the bridge from the CS to the SS. These linkages are crucial for harmony of the e-commerce support system.

3.3 Model of the e-system infrastructure

Thus far we have introduced the e-commerce functional model. This model provides us with the framework within which we can propose the preliminary e-commerce system infrastructure (see the Figure 3). Since most of the modules appearing in this figure have been already briefly mentioned when the functional decomposition has been discussed, we will here only summarize their roles. Upon entering the system (INPUT), the customer interacts with the personal agent, which is responsible for the customer identification (including initial profile generation) and the support strategy selection.

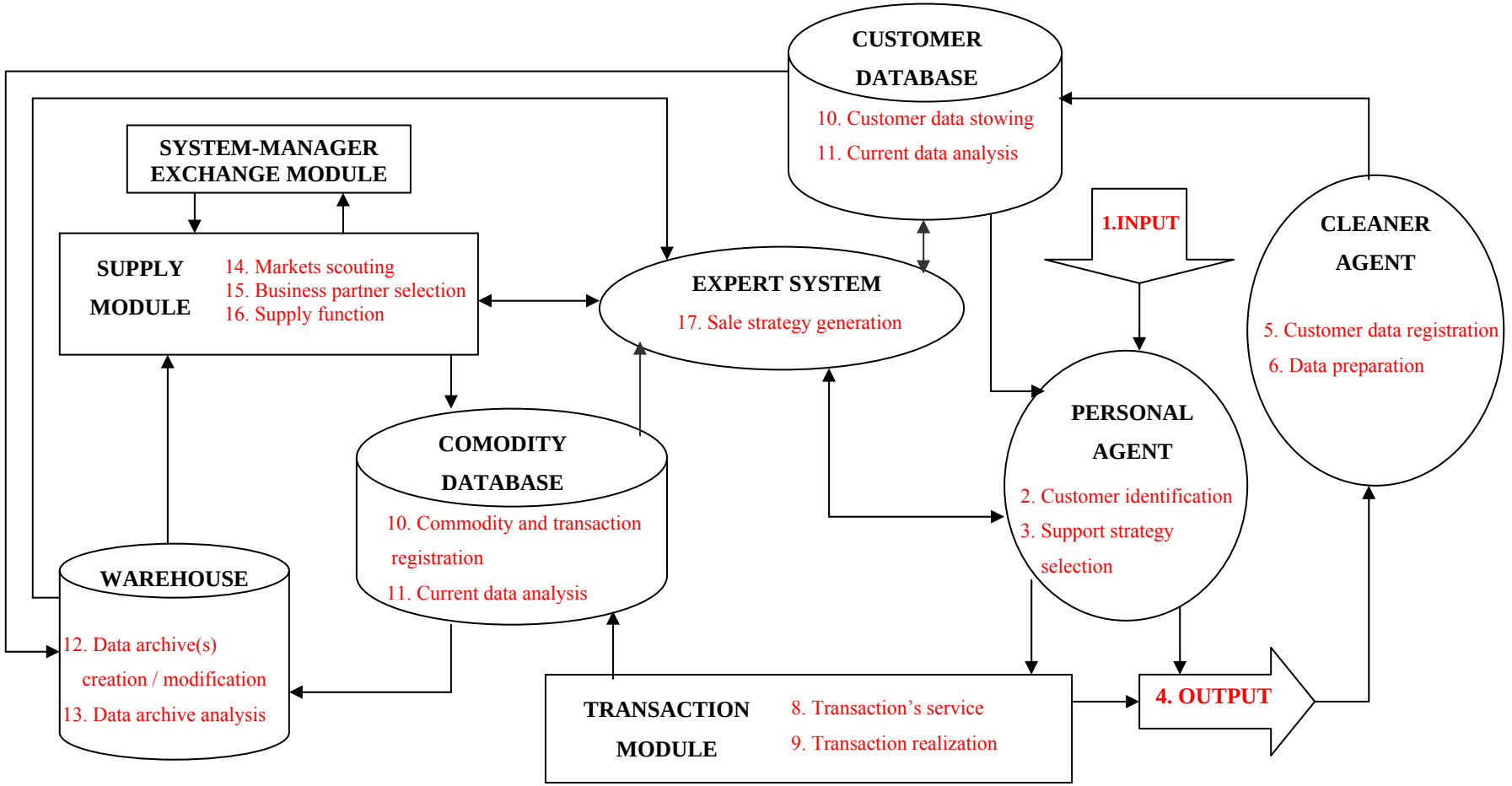

Figure 3. Preliminary (general) e-commerce system infrastructure.

When the customer is ready to complete a transaction, the transaction module will process her order and when the interaction with the system is completed (regardless if transactions took place or not), information of the session is sent to the cleaner agent, which prepares the data to be stored in the customer database. At the same time, the transaction information is sent to the commodity database. Both these databases store the "current" data about commodities, transactions and customer behavior. This data is analyzed and the results are sent to the supply module, as well as the expert system responsible for the sale strategy generation. As the data in the customer and commodity databases becomes old, it is then send to the data warehouse where it is further analyzed in search for long-term trends and rules for the expert systems. Results from mining of the data warehouse are then sent to the supply module, where they are combined with the market scouting reports and participate in supply chain management and business partner selection. Finally, the system-manager exchange module is responsible for the interactions between the managers and the system.

4. Concluding remarks

The aim of this paper was to introduce and analyze the general infrastructure for an e-commerce system. We have proceeded in two steps. First, we have presented and discussed a functional decomposition of the system. Second, we have presented a brief discussion of the infrastructure behind each function. It is our belief that our considerations are general enough to be applicable to most forms of e-commerce systems.

The next step will be to further analyze the proposed functionalities and technologies. At this time, our proposal is specified on the highest level of abstraction, leaving a large number of functions and modules in need of being concretized. We plan to move in this direction in the near future. At this time we will also show how the proposals presented here can be applied to a case of an e-bookstore.

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