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Article

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Cogent Business & Management

Provided in Cooperation with:

Taylor & Francis Group

Suggested Citation: Khaneghah, Ehsan Mousavi; Shadnough, Nosratollah; Salem, Amin (2017) : Artemis time: A mathematical model to calculate maximum acceptable waiting time in B2C e-commerce, Cogent Business & Management, ISSN 2331-1975, Taylor & Francis, Abingdon, Vol. 4, <https://doi.org/10.1080/23311975.2017.1405509>

This Version is available at:

<https://hdl.handle.net/10419/206022>

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Received: 04 October 2017
Accepted: 07 November 2017
First Published: 17 November 2017

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Reviewing editor:
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OPERATIONS, INFORMATION & TECHNOLOGY | RESEARCH ARTICLE

Artemis time: A mathematical model to calculate maximum acceptable waiting time in B2C e-commerce

Ehsan Mousavi Khaneghah^{1*}, Nosratollah Shadnoush² and Amin Salem¹

Abstract: One of the main challenges in e-commerce is how to calculate the maximum acceptable time for response to the customer from the business firms. This case has a direct impact on many business concepts such as customer loyalty, satisfaction, and trust. In this paper, a mathematical model is presented to calculate the maximum acceptable time. In this regard, based on a set of functions, while investigating factors affecting the business from customer's perspective, this mathematical model has the ability to use in any kind of B2C-based e-commerce system due to the consideration of the partial elongation set between elements that affect time transparency. The business using this function and managing the elements that affect this function is able to manage its operations in a way that conducts business activities in accordance with client time estimates. This will increase satisfaction and customer' trust in the business.



Ehsan Mousavi Khaneghah

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PUBLIC INTEREST STATEMENT

The maximum acceptable time for the customer, if the business firm ignores it, will cause challenges in business or in continuing it. This paper, by examining the concept of acceptable customer time and its effective factors, describes the relationship of factors based on mathematical functions. This will allow the business firm to be able to decide in a parametric manner about any factors that would be in violation of acceptable time for the customer. The customer directly relates this time to concepts such as customer confidence, loyalty, and the sense of using technology, and its results can be found in research on customer behavior in a business enterprise or the impact of time on factors affecting business such as loyalty, frequency of referral to the commercial firm and, above all, satisfaction.

Subjects: Environment & Business; Management of IT; Computer Science (General)

Keywords: time transparency; maximum acceptable time; customer; B2C; disorder; cost; time value for business; time need to response

1. Introduction

Business is the trade activities at the right time and location (Huang & Benyoucef, 2013; Laudon & Traver, 2013; Low, Kabasunakatuba, & Sharma, 2013). As expressed in the definition of trade, business activities are only acceptable at the right time. The right time for business can be discussed in two fields. The first part, which relates to the time of the trade, emphasizes that business should occur at a time that leads to the need for the buyer and seller. The second part, dealing with the time of trading, points out that all trading activity should be such that does not violate the cause of the formation of the transaction or create a new demand in the customer (and in some cases business side). On the other hand, the time of trading should be acceptable for both the seller and the buyer and not cause any of the parties to quit trading (Wang & Zhang, 2013). Utilizing the Internet as a distributed text-based system and a platform for e-commerce provides many benefits such as doing commerce with decreased constraints in time and space (Huang & Benyoucef, 2013; Turban, King, Lee, Liang, & Turban, 2015a; Wang, Wang, & Liu, 2016).

E-commerce has replaced the concepts of customer and business with their agents. A customer's agent is a simple subsystem that follows the customer's requests (based on the rules and Internet relations of e-commerce pattern, applied rules of traditional commercial infrastructure, and the rules of the Internet itself), until responding to the request. The business's agent is likewise a subsystem responding to the business requests based on rules of the Internet and e-commerce patterns (Mohapatra, 2013).

There is a logical relation between Internet and e-commerce, which defines market structures on the Internet. The market area is a collection of existent machines on the Internet; seller means the websites, which are dependent on a commercial enterprise, and the buyer is an Internet user who has the possibility of buying (Turban et al., 2015a).

In this type of trading systems, doing trade in a special time and location is not necessary (Andam, 2014; Mohapatra, 2013). This is due to an increase in the number of providers of services or goods (business) and consumers (customer). In e-commerce due to increasing the number of providers and customers at any time and location, potentially an ability pointed time and place turns to start activities time and location related to e-commerce (Chiu, Wang, Fang, & Huang, 2014; Mohapatra, 2013). Although this is a strong point of reference for e-commerce systems as compared to traditional trading systems, it causes that concept of time in this kind of e-commerce systems to takes complex patterns of trade compared to traditional systems. In e-commerce systems, based on the type of e-commerce system and the nature of the supply and demand function, the definition of time is based on one of the two main elements of the trade. If the value of supply function is larger than demand, then the time orientation of the business will be passed to the customer side (Laudon & Traver, 2013). In such systems, time is the acceptable time for trading in a business enterprise for a customer. This is evident in a particular kind of e-commerce system called B2C systems.

Typically, in B2C e-commerce systems, the number of businesses offering providers that provide services and goods at any given time and place is such that the focus of the time is on the customer, and the customer determines whether the trading time is acceptable or not. In these systems, the formation of customer's needs triggers the business activities. On the other hand, it is important to note that in e-commerce systems, unlike traditional trading systems, activities are carried out on a technological platform. Nature of technology is in a way that user (buyer) expects to reduce response time. In this type of trading system, the time it takes to trade, in addition to the traditional concept of trading time, includes a set of technological and psychological parameters of technology that must be considered.

The Internet fills three main needs: (1) to facilitate operations from customer and business perspectives, (2) to increase communications for improving and resolving the requests, and (3) for scalability. In addition, challenges arise from nature of Internet and definition of trading systems based on that. The Internet is a textual distributed system; therefore, it has many features related to distributed systems. One of the most important of these features is transparency (Gupta, 2014; van Steen & Tanenbaum, 2016).

Transparency in its general sense in the literature of distributed systems means that the user should be away from the complexity of the underlying layer, and the system must work in some way that all activities and features of activities to be considered in terms of local activities by the user. Defining a set of transparency for distributed systems is all in the direction of the importance and transparency for the user (Gupta, 2014).

Transparency means that an e-commerce management system must manage and execute e-business activities in such a way that the user, both in terms of spatial access and time access, has the feeling that all activities are performed on the user's local machine. This case is established for location access in many respects. Because in a distributed system, the user always uses call by name instead of call by address. This will allow the Internet-based e-commerce element to give the user the feeling that the location of all transaction-related activities is on the user's local machine. This has a more complicated situation for a time; an e-commerce is running on a network. Therefore, the occurrence of some events that make passage of time is understandable to the user. On the other hand, the passage of time is a real event in a system. This issue is more complex in distributed systems (Carnmarata, McArthur, & Steeb, 2014). The existence of multiple challenges in the field of unit time, create a sensing unit of time, generating global time in distributed systems, and time-related concerns in distributed systems such as the Internet, they all signal complex nature of time in these type of systems and consequently in e-commerce.

In this environment, effective factors on e-commerce are more complicated than traditional commerce. In addition to traditional commerce elements, some other parameters are to be considered because of the Internet is a distributed text-based system. These parameters are under different categories such as psychology, sociality, politic, security, and culture. Each category in the marketing area needs a reductionism analysis to produce an acceptable time. To clarify, this issue must be considered sociological science and human behavior science and studies of human subsystems. In marketing concepts, the focus is on the customer subsystem and modeling its behaviors (Altounian, 2016; Nilashi & Ibrahim, 2014; Pei et al., 2015).

Therefore, in today's e-commerce (especially in B2C e-commerce) concept of time has three specific and unique complexities, as compared to traditional trading. In this kind of systems, time is total dependence on the buyer and its definition is based on that. The buyer expects to use the technology platform to reduce the time spent on trading activities and, on the other hand, due to the use of the distributed Internet system as a platform for e-commerce the concept of time transparency is needed to establish for trading activities.

The maximum acceptable time of e-commerce is defined in terms of time transparency. In e-commerce, expanding the concept of time has led to a series of complexities arising from the application and the nature of technology (Internet-distributed system) to add to the traditional concept of time. This has led to need e-commerce to calculate acceptable times for trading as a necessity for the buyer. If an e-commerce system is able to calculate the maximum acceptable time for the customer, then the system can do the operation in this time by changing its elements.

In this paper, the concept of acceptable time in B2C e-commerce will be discussed. For this purpose, a mathematical model based on the development of the Cobb–Douglas (Andam, 2014; Chiu et al., 2014) function will be presented to calculate the maximum acceptable time. This mathematical

model, while investigating factors affecting acceptable time in B2C e-commerce, examines the impact of effective variables at acceptable times over each other.

This paper attempts to determine effective elements of time transparency besides defining it, by providing a logical schema of e-commerce. Every business has a time value for a user that defines it. In Mousavi Khaneghah et al. (2013) introduced a time value model. Now consider a time value that is looking at setting up a system that could measure the amount of acceptable waiting time for a user who used the Internet as a business platform.

2. Related works

Since 1990, the Internet has been used as a communication platform bringing capability for commerce so that the business would be done by web pages. The Internet has provided valuable opportunities for transparent and free communication (Barnes & Hunt, 2013; Steinfield, 2013; Wang & Zhang, 2013). Like any other system, the concept of performance is also considered for e-commerce.

Performance is one of the major challenges of e-commerce and the business world and has attracted several research works, determining effective factors on performance (Hackl, Kummer, Winter-Ebmer, & Zulehner, 2014; Sila, 2015) and second, measuring and upgrading this performance (Datla, 2016; Dickinger & Stangl, 2013; Kacen, Hess, & Kevin Chiang, 2013; Poggi, Carrera, Gavalda, Ayguadé, & Torres, 2014). One of the efficiency issues on the performance of e-commerce is the response time.

In measuring and improving the efficiency of e-commerce, some of indicators and factors affecting performance are due to the fact that these systems are in fact implemented a commercial system. The other is due to the definition of e-commerce on the Internet. Some parameters like the time it takes to trade are dual parameters. Features such as the terms of buyer and seller, the buyer and seller behaviors, the nature of trade and trade culture are the parameters that have been effective in responding to user requests because this system is an implementation of trading systems. Parameters such as technical capability, e-business features, how to implement business websites (Arora, 2016), the way users access businesses and tools used to process requests are some of the effective parameters on the response time of requests that arise from the implementation of a system based on a distributed system (Arora, 2016).

According to Belk et al. (2015) and Poggi et al. (2014), it is so important because of overload time. Customers could face an increase in response time, and some of their requests may then be rejected. This finally reduces the business income. In addition, some research shows that customers abandon an e-commerce site permanently if it seems to take too long on their first visit (He, Ren, & Zhang, 2014; Poggi et al., 2014). Responsiveness is a concept that has a high priority in e-commerce because one of the most important reasons for transferring business to the e-commerce is to remove restrictions and constraints due to doing business at the special time.

Major activities in the field of time in e-commerce are based on reducing response time (Gilbert, 2014; Hristoski & Mitrevski, 2013; Poggi et al., 2014). In the area of reducing response time to user requests in e-commerce, the focus is on two issues: (a) using high-performance computing systems and (b) the use of special purpose systems to access website (Chiew & Renaud, 2015). In other words, most of the activities undertaken in response to customer requests in e-commerce systems are due to the implementation of the listed trading system on a distributed system. When an e-commerce system reduces the response time to user requests, it implies the sense that the system is capable of time transparency.

The word "Transparency" in most general cases means, "Easily seen through or understood" (Aarts, Chalker, & Weiner, 2014). It usually implies features like trustfulness, accessibility, accuracy, accountability, and clarity (Ghosh, 2014; Grimmelikhuijsen & Meijer, 2012; Grimmelikhuijsen, Porumbescu, Hong, & Im, 2013; Verissimo & Rodrigues, 2012). In its general meaning, it provides

both concepts of effectiveness and compliance and facilitates them (Ghosh, 2014; Tanenbaum, 2015).

Regarding the concept of transparency, and with the definition of transparency in distributed systems (Tanenbaum, 2015) as a platform for e-commerce, the concept of time transparency can also be used for time. The concept of time transparency has not been used in the literature of e-commerce. The equivalent term, i.e. maximum acceptable response time, is used in e-commerce to optimize website design.

Only industrial production environments like production lines and supply chain management systems (Bozarth & Handfield, 2015; Monczka et al., 2015; Tayur, Ganeshan, & Magazine, 2012) until now have reviewed the tolerance threshold of completing operations. The main reason industries should follow this tolerance threshold is that a delay in each division of a production line leads to a propagated delay. In addition, estimating maximum time of completing the production process, regarding the inter-departure delays, is one of the main challenges of production management systems (Umeda et al., 2015).

In these type of systems, the concept of maximum acceptable time is used for the customer. If the production line or supply chain is a set of systems, what is the total latency of the system, considering the delay in each system? And does this delay match the acceptable latency of the customer for the receipt of the product or service? In the event of a mismatch between system delays and the maximum acceptable time for the client (the greater the delay compared to the maximum acceptable time for the client), based on what improvements, this system delay can be reached with the maximum acceptable time for customer delays?

In these systems, the focus is to extract maximum acceptable time for the customer based on history and type of trade. This means that from the view of the originator of a production line or supply chain, the customer decides on a maximum acceptable time, based on history, the nature of trade, and importance of the business from customer's view.

In all trading systems, including e-commerce, the main pivots of all processes in e-commerce are its two principal stakeholders, the business and the customer (Turban, King, Lee, Liang, & Turban, 2015b). The concept of a maximum desired response time to the customer is important because it is effective as a vital factor in customer satisfaction and, consequently, an effective factor of customer loyalty. The main reason for both of these is the competitive nature of the Internet and e-business environment.

From a logical view or from a psychological view, users move from the side of traditional trading to e-commerce, expect to reduce the time required to respond to their requests due to use of technology (Ivaturi & Chua, 2016; Viglia, 2014). In other words, users create a logical connection between technologies and decrease response time, and they believe that any high-tech business enterprise will see a reduction in the response time to user requests.

3. Logical schema of e-commerce models

E-commerce tries to model traditional business using capabilities and features of the distributed Internet; these systems are in fact a development of traditional trading on the Internet. These systems attempt to solve challenges and constraints of traditional trading, using Internet-distributed system feature.

To understand e-commerce and to examine the concept of time transparency it is needed to have a thorough understanding of the nature of transparency and how to implement it in e-commerce. In this section, the topic will be followed by how the concept of transparency is discussed in the e-commerce system, in order to study the concept of time transparency and maximum acceptable time for the user.

The concept of maximum acceptable time to receive an answer to a user's request by e-commerce can be synonymous with the concept of time transparency. In transparency, the emphasis is on the fact that the user should keep the underlying complexity in place, and the system will give the user the feeling that all activities are done in the local customer system. This issue of transparency in e-commerce systems means that the system must pass on the feeling to the client that the activities are carried out in the client's local time system.

For understanding customer's local time system, assume that customer enters a business for trading; Based on a set of factors, the customer assumes that responsive system (trade system) must respond to the customer in a specific time. This time-based system equals customer's imagination from the time it takes to respond to the requests, taking into account conditions of e-commerce and business environment. The customer expects to be answered a response to local time system. There is a difference between local time and local location concepts. For example, consider a customer, who is using e-commerce mail system, customer's local location system includes source and destination. While customer local time system includes the time, it takes to respond to a request for a postal packet.

If the user assumes that the response to the request is performed at the local time-level system, the time for the operation is acceptable. So, as long as the concept of transparency in the e-commerce system is established, the time to perform the activity is acceptable to the user, and the maximum acceptable time for the user is equal to the maximum time for establishing the system transparency.

So first, a total layering of e-commerce based on a logical model must be presented and the system should be studied based on this layering. Particularly, the success rate of using e-commerce is needed to be examined to facilitate operations of commerce and to establish transparency of operations. This depends on the nature of the system and its execution. Another way to define the acceptable time regarding the mentioned elements is using archway functions.

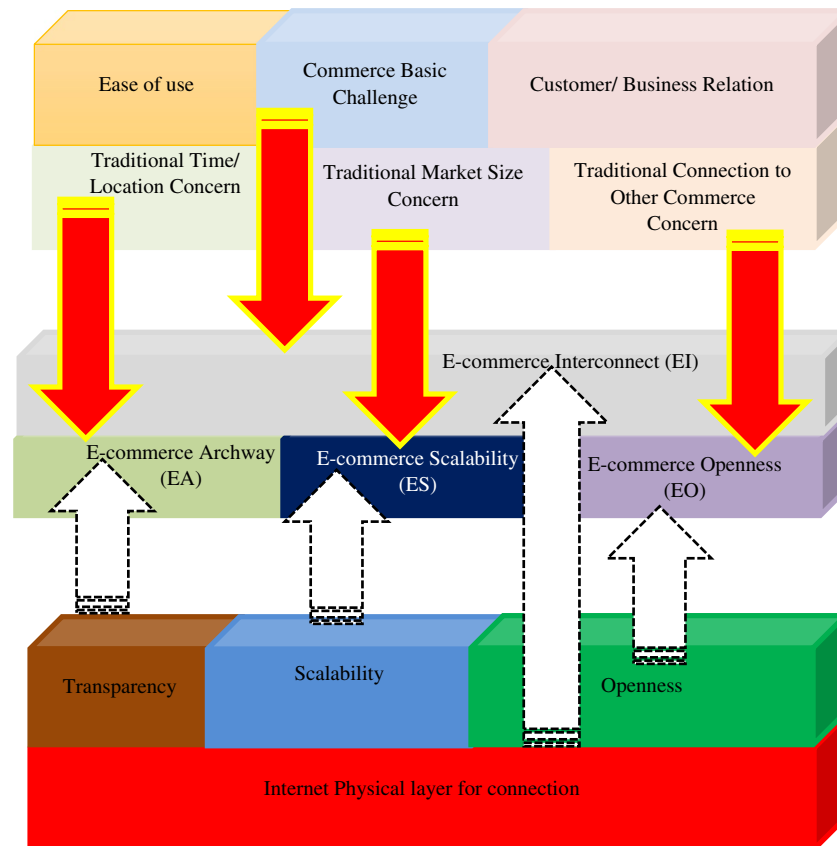
In the case of archway functions (described in Section 3.1), it is important to note that when it comes to a particular type of transparency, such as transparency, in e-commerce systems. It should be noted that a set of parameters mentioned below affected on a time transparency:

- (1) Type of trade
- (2) Nature of trade
- (3) Buyer and seller behaviors
- (4) Patterns and rules governing business in community

These parameters affect buyer and cause the buyer to decide on a maximum acceptable time to receive an answer to his requests. Considering all of these parameters to calculate time, transparency model and, consequently, calculating maximum acceptable response time, creates a very complicated model. Based on a systematic approach, the focus of transparency can be identified. For example, in terms of time transparency, the focus is on time-based transparency, and the archway functions in this paper represent the effects of factors affecting trade in the time dimension and show the factors on business that effect on the maximum acceptable time.

Figure 1 shows the logic of e-commerce. This Figure represents spaces that create e-commerce. As seen in Figure 1, first space (the first layer above Figure 1) represents main challenges facing traditional commerce. The second space is main characteristics of the e-commerce, which combines features of the traditional trading system and characteristics of the Internet system. Third space shows the basic features of the distributed Internet system.

Figure 1. Logical schema of e-commerce models.



As seen in Figure 1, one of the most important features of e-commerce in Layer 2 is the creation of archway functions to ensure transparency for users and to keep users from the complexity of trading and using the Internet-distributed system.

In Figure 1, the first layer, features such as the need for the easy use of the business system, the challenge of communication and interactions in business, market size, communications and interactions between customer and business, and time and location challenges of traditional trading have been shown. These are the main challenges that led to creating e-commerce.

In Figure 1, the schematic representation about traditional commerce is an abstract scheme including fundamental concepts of commercial needs. In other words, the cause of formation of e-commerce is to respond and implementing these triple sets.

The second layer represents main components of the e-commerce, in these layer four features of e-commerce systems are:

- (1) Scalability (ES)
- (2) Openness (EO)
- (3) Archway (EA)
- (4) Interconnect (EI)

These four features are in fact use of capabilities of the Internet to resolve challenges and problems mentioned in the first layer. These features are in fact characteristics of e-commerce derived from traditional trading and the Internet. Drawn arrows between first and second layers indicate what challenges in the first layer are answered by elements in the second layer.

The third layer shown in Figure 1 is the Internet and laws governing it, including protocols, connections, and communications between machines, communication mechanisms between applications, and everything considered as the Internet in its public concept. This layer has the duty to create a distributed widespread system as the fundamental need of e-commerce and as a point of differentiation with traditional commerce. If assume it as a distributed text-based system, then openness, scalability, and transparency are responsibilities for this layer.

The arrows drawn between the third layer and the second layer in Figure 1 represent capabilities that the Internet has placed on e-commerce.

In Figure 1, the main business challenges that focus on increasing demand and supply functions are responded to based on interactions on the Internet. The Internet implies the expansion of demand and supply functions. On the other hand, increasing number of customers and businesses will improve core challenges of commerce such as competition, representation of products with better quality and costs, and challenges posed by the nature of trading.

The relationship between customer and business in e-commerce is more depended on nature of the business and patterns of service used by distributed systems. E-commerce systems use customer server and peer-to-peer approach, to the model customer and business relation. In addition, they have also defined new communication and interoperability models between the buyer and seller based on the technology.

As seen in Figure 1, the ability to scalable and openness in e-commerce is based on the concept of scalability and openness in distributed systems. In distributed systems, these two features will cover challenges associated with traditional market size concern, traditional connection to other commerce concern. Scalability and openness, will increase the number of customers, vendors, as well as increase the chances of responding to requests in the e-commerce. The markets related to e-commerce, unlike traditional ones, have a high dynamic and interactive nature due to the existence of these two features.

As shown in Figure 1, the concept of transparency is a concept that has been transferred from distributed systems to e-commerce. In this paper, the concept of archway function is used to understand the concept of transparency in e-commerce more precisely. The e-commerce uses the concept of transparency to solve time and location challenges in e-commerce. Ideally, when it completes full transparency in e-commerce, the user engages in trading activities regardless of time or location (Altounian, 2016; Howe, McMahon, & Propst, 2012; Nilashi & Ibrahim, 2014). The archway functions attempt to analyze and understand factors that contribute to transparency. For example, in order to establish location transparency, archway functions focusing on the location, regardless of the buyer's and seller's locations, analyze the factors affecting trading, and define the virtual markets.

As seen in Figure 1, in e-commerce, EI, EO and ES units should be able to establish transparency defined by the EA. For example, when creating location transparency, after extracting factors affecting the transparency of location by EA, EI uses the concept of communication and interactions between multiple websites related to a single business enterprise to provide the concept of location transparency to the customer. Customer will be served at any location regardless of the location of company and itself.

The archway function makes it possible to map factors affecting e-commerce in a given context by deciding the impact of each factor on a specific dimension, such as time and location. In this paper, the goal is to calculate the maximum acceptable time for the customer. Therefore, the core of the archway function is an acceptable time for the customer. The archway function is written in this paper maps factors affecting e-commerce into acceptable time location for the customer. Therefore, that can accurately understand effects of factors derived from this mapping, to calculate the function for maximum acceptable time for the customer.

This paper focuses on a particular type of e-business systems known as IBM B2C e-commerce. In other words, the goal is to find the concept of time transparency and, consequently, calculating the maximum acceptable time for a customer to receive an answer from a business that uses in IBM B2C model. The IBM B2C model follows Figure 1, so results obtained in this paper are acceptable for any B2C e-commerce model compliant with Figure 1.

IBM's Patterns describe the manner of communications between customer and business in a balanced status. Three-tier architecture of this model and separating the whole system into three layers: the customer layer, the middle request distribution layer, and the business layer (the Enterprise information systems layer). It maintains that design and development are based on the traditional product distribution (Stark, 2015). This pattern matches the logical schematic of Figure 1.

3.1. The archway function for time transparency in e-commerce systems (AFT)

As discussed at the beginning of Section 3, archway functions focus on the concept of an attempt to analysis effects of factors affecting e-commerce in a special domain. In traditional trading, trading is affected by a set of social, economic, operational, and buyer-seller behaviors, also nature of goods or services traded. All of these factors affect the maximum acceptable time and allows the customer to trade based on above consideration, as well as the trading history, to determine the maximum acceptable time. On the other hand, given that trading is done in a system, a space called "disorder" can also be defined for this system. Disorder space is a set of factors that are not predictable and affect the trading process. Obviously, a set of factors of disorder space is affecting acceptable trading time.

In e-commerce, in addition to conventional trading spaces, there is a space called technology space that affects trade. In addition to having a direct impact on trading, technology space also influences other effective trading spaces. This space will affect many factors affecting on business. For example, in terms of time for bargaining, this space makes it possible to create a client's mental sensation in order to reduce acceptable trading time. As shown in Figure 1, this space makes it possible to create a set of tools for developing the concept of business. The technology space directly affects many of concepts of traditional commerce such as customer satisfaction.

To derive the influence of the factors affecting trading on acceptable time the archway function for time transparency (AFT) can be defined. The AFT is a two-step function.

This function transforms the set of spaces for effective parameters of the economy, culture, society, politics, human relations, and value of products from a customer or producer perspective, which has more or at least equal dimensions in the real world, into the predefined sets.

In this paper, the three space: Real Society, Traditional Commerce, and Technology, has been selected as AFT's first-phase output spaces. In other words, AFT, in its first step, maps out all effective parameters on doing business in one of the three spaces in a time dimension. For example, a parameter such as a buyer behavior is converted into three time parameters by AFT and placed in the three spaces. The reason for choosing these three spaces is obtained from systematic vision. Because e-commerce is a system, there must be a space that can be used to determine the impact of intersystem factors on time dimension. The two areas of technology and traditional commerce are intersystem spaces. Traditional trading space due to the fact that e-commerce is, in any case, a trading system and the technology space because the nature of the space is based on technology. The real society space is also a space in which impact of environmental factors of e-commerce is determined in the time dimension. When trading is in progress, customer and business are not in an abstract, but in a real environment. Many of the parameters affecting time transparency are due to the environment of the trading system.

To understand the AFT, input spaces considered for the functionality AFT are shown in Figure 2.

Figure 2. Physical schema of retrieving the effective parameters on Acceptable Time based on the parameter generator spaces.

Source: Mousavi Khaneghah et al. (2013).

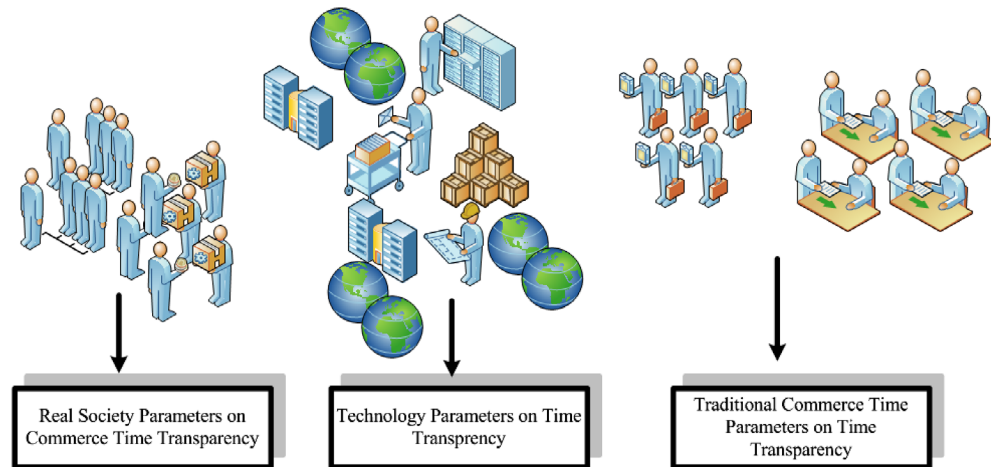


Figure 2 is a visualization of the AFT's action. The output of this step transforms three qualitative-quantitative spaces into three quantitative spaces of effective variables of the acceptable Time for Business, which will be used as an input for the AFT.

As shown in Figure 2, the AFT in the first step map and categorize all total effective factors in the maximum acceptable time into three spaces: technology, real society, and traditional commerce. At this point, AFT attempts to extract factors from factors affecting e-commerce that directly or indirectly affect the concept of transparency.

In each of the three spaces mentioned, there is now a set of parameters in which concept of time plays a major role; any space can be considered as an N -dimensional space Which n varies between two and $+\infty$. In all these three spaces, the concept of time exists implicitly or explicitly, so all spaces except the time-space have to be transformed into the acceptable Time for Business space.

For example, in technology space, a set of time parameters can be considered when it ultimately leads to the definition of the concept of time transparency in technology dimension. These parameters such as website design time transparency, the impact of user access time transparency, the impact of graphical interface time transparency, the impact of bandwidth time transparency are at user's disposal. These parameters lead to the definition of the concept of time transparency from technology side for e-commerce. The factors in these three spaces define the concept of maximum acceptable time for trading.

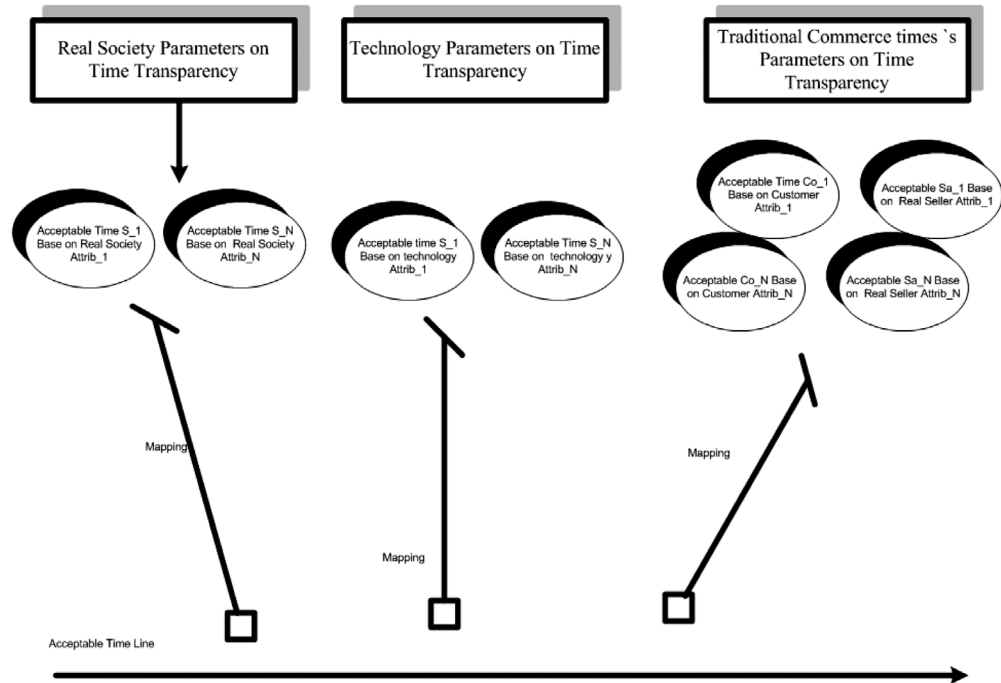
All the factors affecting the trade of these three spaces are conclusive, for example, the concept of the type of the commerce can be retrieved by a set of commercial rules governing the three mentioned essential spaces. Disorder space is obtained from all of them.

Second, the concepts of technology and disorder are converted to the lower layer and transformed to time transparency. The concept of technology in each of the above spaces will be transformed by the use of knowledge in that space if it influences the concept of time. Disorder, abuse of any appropriate actions, is susceptible to the same effect.

Figure 3 represents the actual functionality of AFT. AFT in its second phase maps the space of the effective parameters on acceptable time and generates acceptable time for every three categories of the mentioned.

Figure 3. Actual functionality of AFM.

Source: Mousavi Khaneghah et al. (2013).



As shown in Figure 3, AFT receives N variables for each of the three mentioned AFT instead of receiving three essential spaces as input. The concept of acceptable time is an effective implicit concept, which makes a customer continue working or leave the system.

Therefore, the AFM generates three acceptable timespaces in its second phase; each has more than one dimension.

Based on the material presented, Equation (1) can be achieved.

$$F(\text{time}_{\text{transparency}}) \propto \text{Archway}_{\text{function}}(\text{Technology Space, Real Society, Traditional commerce time Space}).$$

and

$$F(\text{Archway}): \lim_{\text{System} \rightarrow \text{Stable}} \left[\frac{\text{Space (Real Society) and Space (Technology)}}{\text{Space (Traditional Time Challenges)}} \right]_{\text{on (Time Transparency)}} \rightarrow \text{Acceptable} \left(\overline{(\text{Time} \cdot \text{Disorder}_{\text{time}} \cdot \text{technology}_{\text{time}})^{\text{Time}_{\text{vector}}}} \right) \quad (1)$$

In Equation (1), and based on what was stated in Section 3, the transparency function has a high correlation with the archway function, which is defined by three real society, technology, and traditional commerce spaces. On the other hand, as stated, archway function, in the state of the system in a stable state, maps elements of three spaces mentioned in the space of time transparency. The result of this mapping is the creation of three vectors, time, and effective elements of distortion space on time, and elements that influence technology over time, shown in acceptable timespace, as defined in Figure 3.

In Equation (1), in mapping function, the domain of the function is a set of factors affecting trade. These factors are considered in a situation where e-commerce is in a stable state. The sustained

stable state is system state that demand and supply functions have reached their equilibrium state. This does not mean that the demand and supply function is equal, but it means that there are no requests, including requests made by the buyer or seller in the system that cannot be answered by system elements (or market).

In all the spaces affecting trade, the concept of system status is implicit or explicit. This makes above-mentioned spaces more meaningful when the system is inclined toward sustainability. On the other hand, the reason for getting the limit of the system is the impact of each of spaces affecting trade on time transparency or the maximum acceptable time to meet a customer's request. As shown in Figure 3, the result of this mapping expected to be a set of vectors on the vector of acceptable time. Therefore, mapping result is sure to be in the acceptable space, and mapping result is in form of a vector. As shown in Equation (1), the result is a vector of time, disorder, and technology. This was expected from Figure 2 since time including system time and work time is considered as an effective parameter on acceptable time as a system parameter.

Two perceptible concepts of time and time to do work are directly in transition to the set of effective parameters on time transparency, but they are being transmitted to the lower layer and transformed to time transparency, one by one and without regarding the real locations in real operations.

Time in this situation also includes the concept of time challenges in traditional businesses. The vector of time in the output of mapping involves both system time and time constraints governing customer and seller in any type of business, regardless of the type of the business.

On the other hand, technology is considered as a system generator. Therefore, it is expected that the effects of technology on acceptable time as a vector in output will be mapped. Based on the system theory, since the concept of technology is one of the two elements that produces and develops an e-commerce, therefore, technology vector expected to be part of mapping result. This also applies to distortion. According to system theory, in any system, the concept of distortion is an integral part of the implementation of the activity and since acceptable time for the customer is the result of a series of activities in the system, so in mapping output, the formation of distortion vector concept is observed.

The concepts of technology and disorder are converted to the lower layer and transformed to time transparency. Disorder, abuse of any appropriate actions, is susceptible to the same effect.

If Equation (1) is rewritten in terms of timing and acceptable time vectors, then Equation (2) can be obtained.

$$f(\text{archway}_{AFM}): \lim_{\text{Time} \rightarrow \text{Stable}} \left[\begin{array}{c} \overbrace{[\text{traditional TimeChallenge technology disorder}]_{\text{Real Society}}}^{\text{and}} \\ \overbrace{[\text{traditional TimeChallenge technology disorder}]_{\text{Technology}}}^{\text{and}} \\ \underbrace{[\text{traditional TimeChallenge technology disorder}]_{\text{Traditional Commerce}}} \end{array} \right] \xrightarrow{\text{time transparency}} \left(\begin{array}{c} \text{acceptable Time}_{\text{realsociety}_{\text{vector}}} \\ \text{acceptable Time}_{\text{technology}_{\text{vector}}} \\ \text{acceptable Time}_{\text{time-Challenge}_{\text{vector}}} \end{array} \right) \quad (2)$$

In Equation (2), the concept of redefining the real society, technology, and traditional commerce timespaces is used, based on a vector $[\text{traditional TimeChallenge technology disorder}]$. For this, archway function redefines three spaces based on three traditional time challenges, technology, and disorder in the state when the system is in equilibrium. This makes it possible, in any space examined, that the existing elements are of type traditional time challenge or of type technology or of type of disorder and other elements in space, If affected by one of the three factors

mentioned above, their impact on mentioned factors remains in the space. If they have no effect on three factors listed, they should be eliminated from the spaces. The focus of this mapping is based on time transparency. The results of this mapping are equal to three acceptable Time_{realsociety_{tvector}}, acceptable Time_{technology_{tvector}}, and acceptable Time_{time-Challenge_{tvector}} vectors. The vector acceptable Time_{realsociety_{tvector}} is in fact the real society's space that in which only factors affecting time transparency exist. It is in form of a vector because it follows from mapping of a space in a vector. This is true for other two vectors.

Equations (1) and (2), based on the archway function, attempt to extract factors affecting time transparency in e-commerce. Based on Equations (1) and (2), real Society, technology, and disorder spaces are three main spaces affecting the concept of time transparency. Therefore, acceptable Time_{realsociety_{tvector}}, acceptable Time_{technology_{tvector}}, and acceptable Time_{time-Challenge_{tvector}} vectors are factors affecting time transparency in e-commerce.

3.2. What does transparency mean

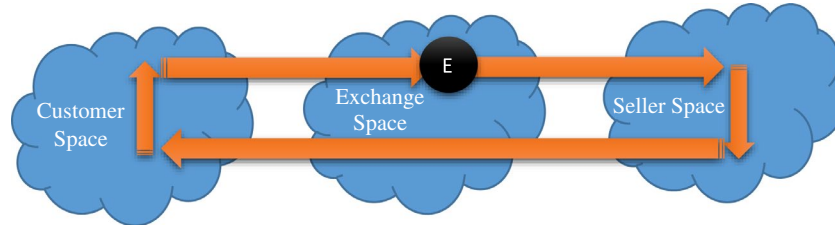
In a preliminary view based on Equations (1) and (2), this can be argued that if a transparency system is to be established, it must be able to manage the three vectors listed above: (a) the user has a long time waiting for a response from e-commerce in the system. It is equivalent to the user estimation waiting time to get an answer from the system. (b) From user's view, duration of activity per unit of the system is irrelevant and only waiting time for response is important for the user. This will allow e-commerce to keep the user from the complexity of user's application execution process. (c) Because one of the user's criteria for determining the maximum acceptable time to conduct an activity is the concept of operation history, e-commerce must respond to similar activities at similar times. This makes user always assume that experience of working with e-commerce is always fixed in time. In other words, for e-commerce, regardless of its current situation and how it works in the system, it tries to respond to similar user requests at similar times. To manage acceptable Time_{realsociety_{tvector}}, acceptable Time_{technology_{tvector}}, and acceptable Time_{time-Challenge_{tvector}} vectors so that three conditions are expressed, concept of the transparency manager should be discussed in Figure 1 in second layer. The manager of setting time transparency on second layer of Figure 1, should manage three mentioned vectors so that the three conditions (a)–(c) maintained at each moment of system lifetime. In IBM B2C e-commerce model, the three main elements of business can be considered: customer space, seller space, and trading space.

The terms of the buyer's space and seller's space are all activities and the physical and electronic locations that the seller or customer use to trade. Obviously, activities such as searching, receiving information, making decisions about buying, doing shopping, and websites and computers used by the seller for this purpose constitute seller's space. On the other hand, providing information, advertising, conducting any activity that leads to recognition of service or goods, as well as websites of the seller and computers used for these activities are part of seller's space.

Trading space is most important space in e-commerce and includes all physical and electronic activities and locations where buyer and seller deal and collaborate. It is important to note that not all buyer or seller spaces may be used for trading, therefore, in the trading activity area, transaction activity is created for a service or item X that is used to carry that part (or maybe the entire space of the buyer or seller).

As seen in Figure 4, in this kind of look into e-commerce, a process model is used. In this pattern, the trading means the creation of a global activity at the customer and buyer spaces. Therefore, no process will start in the system until the process of buying and selling is gone, and as soon as buying and selling process takes place in the trading environment, a global activity in e-commerce is activated in three premises of buyer, seller, and transaction.

Figure 4. Logical schema is the process model of transaction operation.



In Figure 4, the occurrence of E-trading operations, in the trading space has created an overall activity among three buyer, seller, and trading spaces. This overall activity will enable some of the physical and electronic activities, and locations in each of the three spaces mentioned above are activated to allow trading. When it comes to an e-commerce model, there should be a concept of time transparency for all existing elements. If the overall activity shown in Figure 4 is assumed to result in the creation of a trading page for E-trading, therefore, all elements on the E-trading page are expected to be to participate in some way in the overall activity so that they can have a time transparency at any given moment.

This means that if the goal of an e-commerce system is to be transparent to the customer, then each segment of trading E must be transparent. So that the customer can decide on the maximum acceptable response time. It is important to note that if the customer has a timely view of each section of the business activity and assumes that performing the operation in the seller space requires Alpha time, this will be a violation of the transparency of the time, and the customer may, considering that the existence of alpha time will cause the total time of trading E to exceed the acceptable time, will have to quit the system.

4. Mathematical model to calculate maximum acceptable waiting time (time transparency)

The concept of transparency is a concept that has to mean in traditional trading systems as well. In the world of traditional commerce, the customer based on factors and two general spaces: (a) constraints and time limitations on the customer; (b) the value of transaction from the view of the customer, decides on a maximum acceptable time for operation in the trading system. The concept of transparency is an important part of e-commerce, and if there is not transparency, many concepts in the field of commerce will face major challenges. Concepts such as customer loyalty, satisfaction, and frequency of customer referrals are among most important concepts of transparency.

The Internet and its protocols establish seven concepts of transparency and several about location (van Steen & Tanenbaum, 2016). On the other hand, the customer does not have the time constraints to initiate operation of commerce.

This will enable the customer to start trading in an e-commerce at any time interval. The beginning of trading activity at any time will cause that transparencies that govern the time to be meaningless at the beginning of trading, therefore, in e-commerce models, the concept of time transparency from customer's view is meaningless at the beginning of the request is meaningless and there is no need. Transparency at the moment has meant that customer has to apply to a business firm. From now until the moment, the customer receives a response from the trading system (i.e. the overall activity that shown in Figure 4 to be completed), customer needs to have time transparency.

According to what was stated in Section 3.2, what is important to the customer is the concept of time transparency in responding to requests and providing a clear view of how operations are carried out by business. The time between doing business activities in an e-commerce model is important for a customer. On the other hand, the time to start an activity is only important when compared to the relative time of the client; otherwise, it does not matter to the customer.

Based on what is said about transparency in Sections B and C, Section 3.2, the system must have similar time behaviors in the case of similar activities. If this issue, as cited in Figure 4, to be examined, In this case, when the trading space for E and F trades is the same and the e-commerce system has time transparency, similar time activities must be taken to carry out overall activities related to performing E and F. It is important to note that if the concept of transparency is in place in e-commerce, then the point of beginning or ending the activity in the system is not important to the customer and what is prioritized is to carry out work within a specified maximum acceptable time for doing business from customer's view.

The definition of transparency provided in Section 3.2 implicitly includes the concept of TNR or Time Needed to Respond user's requests. Operations performed within one (or several units) of components of e-commerce require performing computational operations. In this case, the amount of time required to execute the operation from the user's perspective should not be greater than the user's need or operation value from the user's perspective. On the other hand, carrying out operations in each of units referred to be time, when it is understood that computational operations performed, is the main job of this unit.

Therefore, one of the factors influencing time transparency is the TNR parameter. The TNR variable is defined in seller space and has a direct impact on time transparency variable. This variable is in the event taken from vector $\text{acceptable Time}_{\text{time-Challenge}_{\text{vector}}}$ and vector $\text{acceptable Time}_{\text{realsociety}_{\text{vector}}}$. The TNR variable represents how e-commerce is priced to meet a customer's request. This estimated time is because time-domain vectors and community effects are mapped to time-space transparency in technology vectors. This mapping makes it possible for a vector of technology to fit nature of time-consuming trade-specific challenges, and taking into account real conditions governing community, to have an acceptable estimate of time it takes to conduct user's activity.

The TNR variable creates an understanding of the state of the e-commerce system and the conditions prevailing thereon. On the other hand, the definition of TNR variable makes it possible to establish a correspondence between e-commerce and production line system. In production systems, according to conditions of society (market) and customer's prevailing conditions, an estimate of the time needed to produce the activity is obtained from the vector of technological factors affecting the time transparency.

The "TNR" variable expresses a number of computations needed for a unit of operation (any unit in which one evaluates computations) in an e-commerce.

Based on the definition, time transparency is dependent on the value the user considers for the operation.

The definition of time transparency implicitly implies that customer considers value for trading in the e-commerce system. The concept of value for business (TVB) is a concept derived from traditional trading. This concept emphasizes that value of the business with its numerical and financial value may vary or be the same. In any case, the value of commerce is priority and importance of business for the customer. There may be little material value in business, but it is important to the customer. The TVB variable is derived from the mapping of vectors $\text{acceptable Time}_{\text{technology}_{\text{vector}}}$ and $\text{acceptable Time}_{\text{time-Challenge}_{\text{vector}}}$ the vector $\text{acceptable Time}_{\text{realsociety}_{\text{vector}}}$.

The TVB variable is defined in the customer space. This variable reflects the value of doing business for a customer. The greater the value of the business for a customer based on TVB variable, the more acceptable time for trading by the customer, and vice versa. This variable stems from the mapping of technology vectors and the effective time of business in a vector of real society; this mapping provides real conditions governing business and the true value of the business from customer's view.

The “TVB” variable expresses a scalar value, which the user considers for operations of a unit.

The “Disorder” variable is the accumulation of variables that have a negative effect on the execution of computations of a unit. Distortion variable indicates factors not shown in Figure 4. As shown in Figure 4, the concept of overall activity is displayed, there may be a set of variables based on the concept of overall activity and trading in any of the three spaces; customer, buyer, and trading that are not seen in the dual mapping of TVB and TNR. These variables are examined in the model presented in the disorder variable.

Equation (3) can be used to calculate the maximum acceptable value of time transparency of the execution of computations of a unit for the user.

based on cobb – douglas:
$$\max_{\text{Acceptable}} \text{Time} = \int_{t=\text{start}_{\text{system}}}^{\text{End}_{\text{system}}} \left(\text{TNR}^{\beta_2} \times \beta_1 \times \text{TVB}i^{\beta_3} \times e^{\text{disorder}} \right) \quad (3)$$

Equation (3) attempts to calculate the concept of time transparency and states that the concept of time transparency or the maximum acceptable time for a customer to trade in an e-commerce can be expressed in stochastic form.

The above function is the expanded model of the Cobb–Douglas production function, with the difference that this function studies the concept of maximum acceptable time of production. After the mentioned period, the operation of the unit does not meet the concept of time transparency from the user’s perspective.

In other words, Equation (3) results from the equivalence between the two e-commerce and the product line. In the production system, the concept of transparency is also established. In a conventional production system, the customer or different units of production line should not be in the process of complexity and manner of operation of the production line (or part thereof), and timing of the operation is transparent in a production line for units receiving service. If operating time in the production line is higher than the specified limit, this means that product line is not transparent to other units or customers. In this situation, customer or other unit needs to have information about the complexity of operation in the production line, in order to increase to be an acceptable time for a customer or another unit.

In e-commerce, the operational unit produces a product that is actually the result of computations as the goal of the user. Based on this assumption, Equation (3) calculates the maximum acceptable time in responding to the request by the unit and transforms the problem of maximum acceptable time of gaining the result into a problem of maximum acceptable time to produce the product.

4.1. More describe TVB

In Equation (3), “TVB” represents the value of computations for the user. In e-commerce models, this issue is equal to the rate of the added time value of computations in each unit of the computational units for both of the customer and business.

The TVB variable from the customer’s view is how much time it takes to receive a response from a business firm. On the other hand, variable in question from the view of business enterprise indicates the amount of investment made by a business enterprise to the extent of obtaining customer satisfaction from a time perspective.

From the perspective of both the fundamental elements of the e-commerce model, “TVB” represents the time cost unit. In production literature, the time cost unit refers to the issue that what amount of cost the producer or the consumer must sustain to receive a unit of production. In this model, a unit of production is equal to a unit of computation in the represented model.

In Equation (3), the above concept can be transformed from time to financial value, based on a set of mathematical rules.

In this paper, if the left side of the equation is in the time dimension, the numeric value of time is used without any transformation. On the other hand, because the “TVB” is in the dimension of cost per time, the scalar coefficient of this variable, (the β_1 constant), is the unit of the time value of cost. Therefore, Proof Dimension:

$$\text{DIM}(\beta_1 \times \text{TVB}_i^{\beta_3}),$$

$$\text{DIM}(\text{TVB}) = \text{time}/\text{Cost},$$

$$\text{DIM}(\beta_1) = \text{Cost},$$

$$\Rightarrow \text{DIM}(\beta_1 \times \text{TVB}_i^{\beta_3}) = \text{time} \tag{4}$$

The cost of TVB in e-commerce can be due to several causes. For example, the customer has used a terminal to access the electronic business. Then some of the value of “TVB” includes the cost of each time unit that the customer has paid to use the terminal or the energy costs of each kind like electricity, heat, or any other sources; the customer spends while waiting to finalize the operation in a computational unit.

In econometric discussions, this case can include time costs of human resources that the customer spends to access the business. Based on Equation (3) an extended mode of “TVB” can be defined as Equation (5).

$$\text{TVB}_{\text{real}} = \lim_{t \rightarrow \text{TNR-time}} \left(\sum_{i=1}^n [\text{TVB} - \text{operation}_i] \right) \tag{5}$$

The spent time cost (meaning the cost of each unit of time for a user) is an important challenge of commerce. “TVB” has an upper bound for any kind of special operation and for each customer, which can be calculated by e-strategists of a business and in e-commerce models. “TVB” is a social and cultural variable which is originated from the presence of a fundamental element of a customer or business (in a manner that human relations are definable in it) in e-commerce.

4.2. More describe TNR

The second identity, “TNR,” is a technology-originated variable that tries to study the technology effects of time transparency in units that need to do computations. “TNR” generally represents that each unit needs how much time to complete a computation. Obviously, the more precise and faster technologies used inside a unit, the more time of computations of a unit decreases.

“TNR” has no lower bound, and its best status is when the time of computations tends to zero, or each unit can do the computation in the shortest time. Therefore, at first, supercomputers seem an efficient solution, but virtual businesses need to use replications to establish some rules of transparency. Multiple replications of a virtual business are one of the most popular solutions to establish location transparency. However, actually using supercomputers to optimize time transparency lacks economic justification.

Based on Equation (3) the developed form of “TNR” can be used to calculate the needed time to complete a unit of computations in e-commerce that shows in Equation (6).

$$\text{TNR}_{\text{total}} = \int \int_{i=1}^n \text{TNR}_i \tag{6}$$

The reason for using an integral to complete in Equation (10) is the continuous nature of computations.

4.3. More describe disorder

Disorder variable is an accumulation of elements that have a negative impact on applied units of the time transparency, and somehow causes an increase of time of computations in these units. Effective elements with adverse impacts on computations of computational units of a business are various. Some are technological and some rooted in the customer, but most come from the structure of the e-commerce. Studying “Disorder” transforms effects of these elements to their time value and enters into the computations of time transparency in the form of the natural logarithm.

4.4. Features of the stochastic disorder element in time transparency

The concept of trade implicitly proved that the most fundamental feature of the customer entity is the time concept and related to this, and as a result, this is a concept called transparency. The AFM is a descriptor of effective entities of time transparency from the customer’s perspective.

The AFM and concept of overall activity also describe elements and variables that affect the concept of customer transparency. In the words, the AFM and concept of overall activity investigate, in a most general sense, what institutions create the concept of time transparency for the customer.

Based on this categorization and observations to design and write Equation (3), it should be considered that three entities of “TNR,” “TVB,” and “Disorder” represent three general categories of entities effective on the principle of time transparency for the customer and other elements can be categorized based on these triple entities. One of the most important factors in Equation (3) is variables of stochastic disturbance. As shown in Equation (4), determining the dimension of these variables is very important.

In Equation (3), the three values of β_1 , β_2 , and β_3 are seen as stochastic disturbance variables. The reason for these variables is that actually representing a stochastic model to cover all behaviors, features, and requirements of time transparency of all possible states is impossible. Even where coded programs and computer systems control and execute the whole operations of the business, the customer as another fundamental element of e-commerce remains.

The β_1 coefficient, about “TVB,” is based on the unit of financial value of time. One of the main features of each system is the need to estimate the cost of a system in terms of financial and time criteria.

The costs of a system can be discussed based on two elements of time and financial costs. In e-commerce, based on the nature of trading, the concept of the value of time is more tangible. The concept of the value of time means that what is the value of each time unit in terms of each element in the system.

In this paper, β_1 is used in the represented Equation (3) to calculate costs of the presence of the customer in the e-commerce environment. Generally, the rule that showed in Equation (7) can be used to calculate the β_1 .

$$\forall \text{ event}_i, \text{ that event is tangible for user: define time} \rightarrow \text{Cost} \therefore \beta_1 = \int_{t=\text{start}_{\text{system}}}^{\text{end}_{\text{system}}} \text{event}_i \quad (7)$$

The most important point about Equation (7) is the definition of the time \rightarrow cost function, which is usually based on econometric rules and in its simplest form by cost–time opportunity.

β_2 in the Equation (3) represents the (partial) tension of time toward the TVB input. It means that it measures time change percent for each percent of change in the TVB input by fixing the TNR input.

“TNR” represents a number of computations, which is needed to complete a unit of operation in a unit. Therefore, the β_2 variable represents a special kind of dependency termed as tension. There are countless definitions for tension in econometrics, but in the Equation (3), it means the rate of impressibility of the environment. Based on the time transparency concept, the tension only means there are disturbances in the description of the model that is not based on the impact of the two concepts on each other.

β_3 represents the (partial) tension of time relative to the TNR input and by fixing the TVB input.

It is essential and important to consider the issues that, β_2 and β_3 are actually raised from some other variables.

When trying to measure these variables in an actual environment of e-commerce, it must be considered that β_2 describes the effects of cultural, social, and economic variables of customers and businesses. In computations, β_2 depends on many other variables such as time to return on investment of the company in case of participation in e-commerce, the economic status of the business and economic, social, and cultural effective factors on both main elements of customer and business. Therefore, it is needed to use correlation theories such as full correlation and self-correlation to calculate β_2 . In most general cases, designing a B2C e-commerce means calculating β_2 based on new conditions and situations of the system (economic, cultural, and social factors) and studying the effects on both elements of the customer and the business in specified intervals. The change frequency of β_2 mostly depends on the environment of e-commerce formation and kind of products and services traded in e-commerce. For example, in normal conditions and economic stability, based on correlation theories of three fundamental effective elements on economics, β_2 should not have rapid and immediate changes for stable markets staples.

β_3 is a variable that needs studying technology factors to calculate it. For instance, parameters like costs of using the Internet, changes in business to support e-commerce, training users in new technologies and investments to create infrastructure and agents of business and customer can be considered. Based on real experience, the more keeping users out of complexities using transparency, the more stable β_3 variables. Thus, e-commerce designers have to calculate β_3 from the perspective of customer and business in specified intervals.

$\beta_2 + \beta_3$ provides precise information about the time reaction against any changes in the data.

5. Studying IBM’s patterns from the perspective of Maximum Acceptable Time for Customer (Time Transparency)

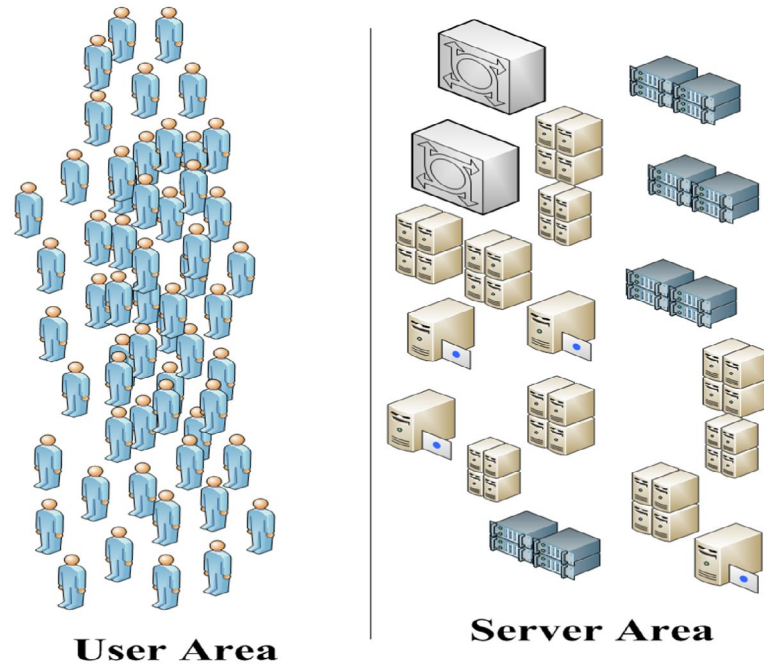
As a model of reference, the IBM B2C e-commerce model is used in many e-commerce portals and commercial establishments.

A study of the IBM B2C shows why a mathematical mechanism must be used to gauge an acceptable trade time based on the method presented in this paper.

The concept of the maximum acceptable time for executing a trade is a concept that has come into the e-commerce model such as the IBM B2C from the world of traditional trade. In the traditional trading system, the customer proceeds to make a purchase decision based on what is called purchase selection mechanisms. These mechanisms determine and specify the approximate acceptable time for the customer at the commerce.

No explicit statement about the maximum amount of acceptable time for the customer has been stated in the IBM B2C e-commerce model. It can be seen in Figure 5, a Logical schema for operations in the IBM B2C model.

Figure 5. Logical schema for operations in the IBM B2C model.



As can be observed in Figure 5, the method being used in the IBM B2C e-commerce model is equivalent to the traditional customer-service model.

In this model, to solve the increasing in the community's demands, there are only two policies that can be taken into consideration. The first policy is to increase the number of service providers on the server side. The second policy is using the concept of cloud computing or cluster systems in order to perform complicated and intensive calculations within a shorter amount of time.

One of the most important concepts of trade is maintaining customer. This factor has a direct correlation to customer satisfaction, and in order to obtain customer satisfaction, a quality product must be displayed at the appropriate time and location. The IBM e-commerce model itself intrinsically lacks a concept called time, and the acceptable time for executing a trade is the only instance in this model where time is taken into consideration, the emphasis on being responsive within the shortest possible amount of time to customer requests.

The concept of time as shown in Figure 2 is derived from three macro-spaces. In each one of these spaces, there are numerous concepts regarding the transaction time. In the e-commerce model, none of the elements of the traditional trading model should be ignored. Therefore, it is required to create a unit in business areas, Figure 5, whose purpose is to calculate the maximum amount of time allowed for trading. If this can find it in its calculations that the customer response system fails to meet the request at a specified time, then it should notify the customer of the inability of the e-commerce system or use another mechanism to respond to the request.

This unit must be able to make a decision, based on Equation (3), regarding the customer wait time on the e-commerce. While considering Equation (3), the creation of the MATime (Max Acceptance Time) unit in the business area, this unit uses a pattern similar to the pattern shown in Equation (8).

$$\forall \text{Request}_\alpha \in \text{Business Area}_\beta \left[\left[\begin{array}{c} \text{Calculate}_\gamma (\text{Business Area}_\beta \text{ Activity}) (\text{workflow and activity types})_\beta \\ \text{time [start - End]} \\ \text{Calculate Equation (3)} \end{array} \right] \text{ and } \left[\begin{array}{c} \text{and [Calculate TVB - Structure}_{\text{request}_\alpha}] \text{ and} \\ [\forall t \in \text{Response}_{\text{time}} \text{ Calculate Disorder}] \text{ and [base History calculate TVB]} \end{array} \right] \right]$$

[if $\gamma >$ Time Transparency THEN use System Policy [CHANGE/ANNOUNCE]] (8)

Equation (8) shows the activities the MATime unit carries out in order to implement the concept of maximum acceptable time. The function is comprised of two computational parts per transaction operation. The calculation of γ is done to determine the current state of e-commerce structure. This issue corresponds to the feasibility of trading at the current state of affairs. Calculation of Equation (3) is based on Equation (4) through (7). If Business Area lacks the ability to execute operations within desired customer range, it will behave according to the system policy.

The most important feature of Equation (8) is taking into consideration the restrictions that govern the system, particularly the distortions associated with the system. It is obvious that each of the phases of the punches has its own associated TNR, TVB, and disorder. Equation (8) can be used for any one of the four phases of purchase in the e-commerce model.

In Equation (8), the concept of the TVB is a concept taken into consideration by the customer. In the traditional trade, extracting the TVB is a multi-dimension activity. Some of it is determined by the activities prior to the beginning of the four phases of purchase. Another part thereof is done during the each of four phase. The major part thereof arises from the (I) nature of the platform (II) the brand concept, (III) the functionality of the commerce platform at the time of the purchase. In e-commerce, in addition to the above spaces, another space known as what the user understands of technology and what technology offers is also added to the TVB generator set. TVB is in the form shown in Equation (9).

$$\text{TVB Buy} \rightarrow [\text{time} \cdot \text{psychology} \cdot \text{Environment} \cdot \text{Location} \cdot \text{others}]$$

$$\left[\text{TVS may be in } t_q \text{ and } t_w \therefore q - w \ll \epsilon \text{ is changes} \right] \text{ or } \left[\text{TVS may be in state}_{\text{Customer}_s} \right] \quad (9)$$

$$\text{and state}_{\text{Customer}_b} \therefore |\text{Space}_s - \text{Space}_b| \ll \text{change transaction satte is change}$$

Equation (9) states the variable nature of the TVB variable based on the five generating elements, as well as the fact that a change in each one of them causes the value of the TVB to change. The actual sample of the change in TVB over time is observed in a situation where a user enters the Amazon website with the mobile device, uses LTE, and the communication model transforms from LTE to 3G during the trading time.

The nature of the TNR is also derived from two overall spaces. The first space is due to the nature of activities that are being addressed within the business area; the second space is due to the time involved with processes and communications within trade area or between trade area and customer.

If suppose that for a time [alpha, beta], consider the e-commerce section of the X Company in Y area, TNR can be described based on Equation (10).

$$\text{TNR} \propto \left[\begin{array}{l} \text{Per Time (unit is define by commerce system)} \\ \lim_{\text{Time system} \rightarrow \text{stable time}} \left[\begin{array}{l} \text{Computation and communication State}_{\text{Business Area}} \text{ } \left. \begin{array}{l} \text{Time} \\ \text{Number of request} \end{array} \right\} \\ \text{and } \left[\begin{array}{l} \text{Communication Average time} \\ \left. \begin{array}{l} \text{time} \\ \text{arrivale} \\ \text{departure} \end{array} \right\} \text{MSG} \end{array} \right] \\ \text{and } \left[\begin{array}{l} \text{Computation Average} \\ \text{Time} \\ \text{Request} \end{array} \right] \end{array} \right] \end{array} \right] \begin{array}{l} \text{Review} \\ \\ \\ \text{Request} \end{array} \quad (10)$$

As shown in Equation (10), the nature of the TNR variability depends on the status of the business enterprise. The nature of the TNR variability is user-dependent. In Equation (3), TNR is also a quadratic variable that has no dependence on the type of the request. Because nature of the requests that can be answered is fixed by a business firm, while TVB is dependent on the type of the request. The variable disorder also uses number function of the same model as Equation (11).

$$\text{Disorder} \propto \left[\begin{array}{l} \text{per event and time} \\ \left(\text{Business}_{\text{System}} \right) \text{ and } \left(\text{Business}_{\text{Environment}} \right) \\ \text{and } \left(\text{Buyer}_{\text{world}} \right) \\ \text{and } \left(\text{Seller}_{\text{technology}} \text{ and } \text{Seller}_{\text{world}} \right) \\ \text{and } \left(\text{multispace}_{\text{Relation}} - \text{influence on Buyer and Seller} \right) \end{array} \right] \begin{array}{l} \text{state} \\ \\ \\ \text{unknown} \end{array} \quad (11)$$

The distortion generating space has complex relationships. In such a way that at any moment of trading, according to its probable and exponentially nature, it may cause the acceptable trading time to reach its lowest (or highest) rate.

6. Evaluation

Amazon (www.amazon.com) is one of the most e-commerce websites in the field of B2C and C2C e-commerce. E-commerce such as Amazon uses multiple business units. In these systems, based on the concept of call rates, they create a business entity to respond to requests. It is assumed that the designers and vendors available on Amazon at the time of negative infinity need to have the transaction.

The need for the seller to create an unlimited need for a buyer has been created at an infinitely short time. Now, Alpha arrives at Amazon for trading. Assuming that trading is over at the moment Beta, now the main question is, is it possible to prove on a mathematical function that the customer will not leave the system in the interval [Alpha, Beta] and will continue to trade? or is there a pattern that shows that the customer remains on Amazon for the duration of the period that the customer and the Amazon are trading?

Suppose Beta is the point at which the customer is given delivery and, based on Amazon's policy, the customer can cancel it at any moment in the trading process. To solve above question, an overview of the trading process by Amazon is required. On the Amazon website, depending on which geographic area the customer is located, it connects to one of the Amazon trademarks, such as the UK or China.

To calculate the answer to the question, it is necessary to calculate the correlation between TVB, TNR, and distortion with the concept of the maximum acceptable amount for trading. Equation (3) shows direct and nonlinear dependence between TVB and Time Transparency, as well as TNR with time transparency and disorder exponential model. User purchases books on the Amazon, the user

enters Amazon site based on a mental environment partly derived from Equation (9), the other part due to the information that comes from his environment about buying a book and an important part of the nature of the purchase need for the book. What is important is the effects of past and history on each of the three mental environments. In Equation (12), general pattern prevailing on user's mind when entering Amazon site in relation to the acceptable time for book trading is shown.

$$\text{Customer}_{\text{BrainImage}} \propto \lim_{\text{time} \rightarrow \text{stable}} \left[\text{Dependency} \left[\overbrace{(\text{Equation 9}) \text{ and } (\text{Environment}_{\text{information}}) \text{ and } (\text{Nature of Request})}^{\lim_{\text{location} \rightarrow \text{every place, time} \rightarrow \text{stable}} \text{Technology}(\text{time, location})} \right]_{\text{History}} \right]_{\text{Time}} \quad (12)$$

In Equation (13), shows the mental situation of the customer in a traditional bookstore in trading time.

$$\text{Customer}_{\text{BrainImage}} \propto \left[\text{Dependency} \left[(\text{Equation 13}) \text{ and } (\text{Environment}_{\text{information}}) \text{ and } (\text{Nature of Request}) \right]_{\text{History}} \right]_{\text{Time}} \quad (13)$$

What makes purchasing from Amazon different from buying from a traditional book market is the difference between Equations (12) and (13).

Equation (12) is actually specific state of Equation (13) influenced by the concept of technology and attempts to create a mental pattern for the user about response time in a stable state. In order to verify the validity of mathematical function presented in different periods, customers were asked to get books based on traditional model and use of e-commerce model. The selection of periods was such that it could include the community. Forty people were examined for a period in a way that their behavior patterns were completely different from one another. Based on the knowledge of nature of e-commerce and Internet, these 40 customers, based on the purchase of books in the traditional market, had an approximate time for [Alpha, Beta] period in terms of subjective pattern based on Equation (12). On the other hand, the difference between the period [Alpha, Beta] in traditional and electronic commerce was considered as the effectiveness of technology in trading. Figure 6 shows the approximate time taken for trading and technology impact time.

As seen in Figure 6, when a user enters e-commerce model for trading, time of technology is considered as an effective parameter. In Figure 7, the relationship between two parameters of the

Figure 6. Maximum acceptable time for operation and technology influence.

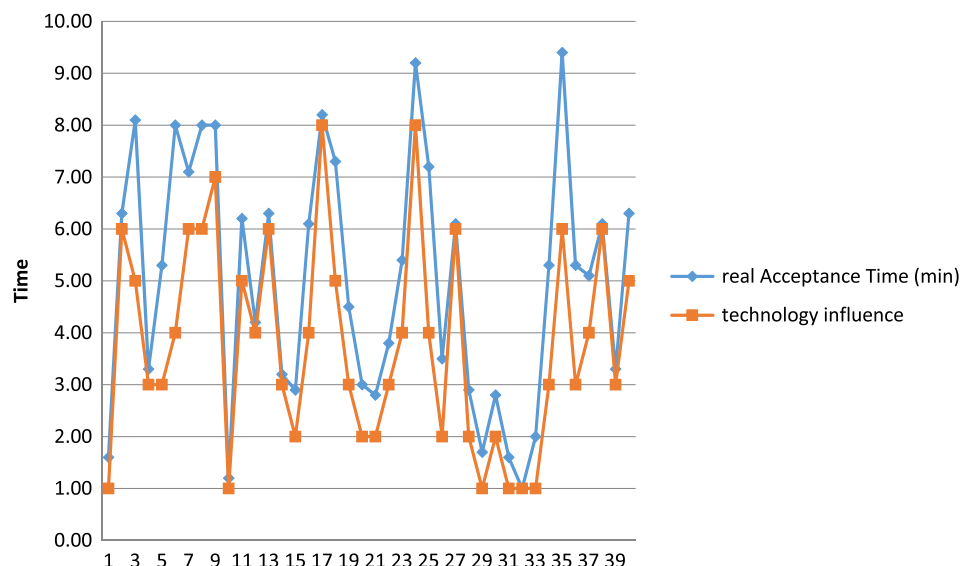


Figure 7. Relation between technology and approximate time.

Model Summary and Parameter Estimates

Dependent Variable: Technology Parameters

Equation	Model Summary					Parameter Estimates		
	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.822	175.410	1	38	.000	-.059	.768	
Logarithmic	.767	125.009	1	38	.000	-.623	3.001	
Inverse	.577	51.890	1	38	.000	5.864	-7.486	
Quadratic	.823	86.005	2	37	.000	-.304	.892	-.012
S	.780	134.594	1	38	.000	1.925	-2.745	

approximate time of trading from user’s perspective and the effective time of technology has been studied.

Based on Figure 7, two parameters have a second-order acceptable regression. With the increase in a number of variables, second-order regression shows a more accurate correlation between two parameters of acceptable time for trade and effects of technology. This shows that, as stated in Equation (3), effective time parameter due to technology has a nonlinear relationship with a parameter of the maximum acceptable amount for trading. An important part of the TNR (as expressed in Equation (10)) is under the influence of technology. Figures 6 and 7 contain an important point, on average; most users enter the e-commerce structure based on what is stated in Equations (9) and (12). Assume that total acceptable business time for electronic trading is their approximation of the state of the e-commerce. This is in line with the feel of users. The technology impact parameter is also part of the TNR, which refers to the status of an e-business. The TNR variable refers to entire technology state and describes the state of whole technology. In other words, in Equation (9), concept of technology parameter includes the entire formula, except for

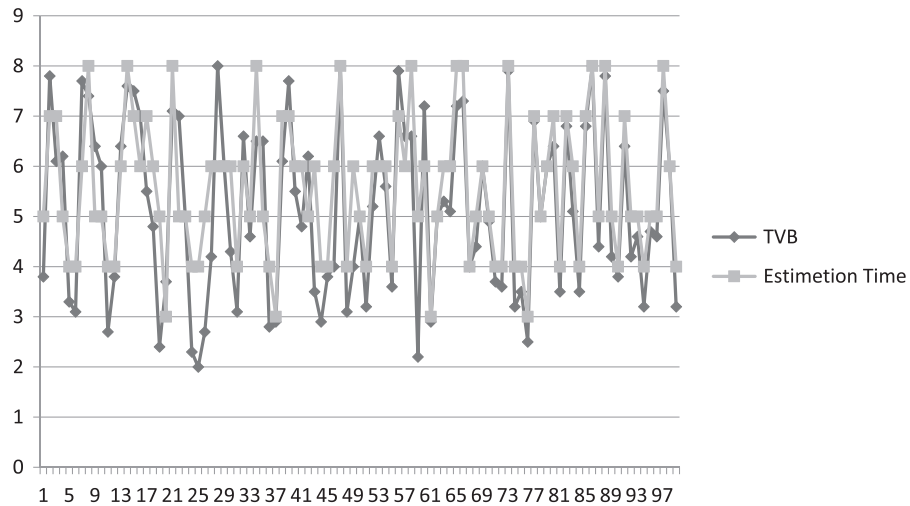
Figure 8. The relationship between the two parameters TNR communications and the approximate time acceptable.

Model Summary and Parameter Estimates

Dependent Variable: Communication

Equation	Model Summary					Parameter Estimates			
	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Linear	.000	.002	1	38	.964	2.157	.004		
Logarithmic	.001	.033	1	38	.857	2.258	-.057		
Inverse	.006	.213	1	38	.647	2.059	.414		
Quadratic	.015	.288	2	37	.751	2.687	-.264	.026	
Cubic	.017	.208	3	36	.890	2.999	-.524	.084	-.004
Compound	.000	.001	1	38	.979	1.887	1.001		
Power	.002	.075	1	38	.785	2.013	-.041		
S	.008	.315	1	38	.578	.573	.239		
Growth	.000	.001	1	38	.979	.635	.001		
Exponential	.000	.001	1	38	.979	1.887	.001		
Logistic	.000	.001	1	38	.979	.530	.999		

Figure 9. The relationship between VB and estimate the response time to requests traded on the specified timeframe.



[Communication Average time] $\left(\frac{\text{time}}{\text{arrive departure}}\right)$ MSG section. Figure 8 shows relationship between two communication parameters and acceptable time to respond to user’s perspective.

As shown in Figure 8, two parameters are weakly interdependent. In the best situation, have a second-degree correlation with each other. Therefore, in the maximum amount of acceptable time to the user, the concept of communication is meaningless and considered weakly. This issue is due to the nature of place independence of e-commerce. Figure 9, represents the status of a user in 100-time units in e-commerce. As stated, the TVB variable uses Equation (13) to describe itself. Equation (12) is a complex function. In this test, based on the parameters mentioned in Equation (9), expected TVB trend is examined for a user, as well as estimated response time for the request.

As shown in Figure 9, the two variables TVB and Time Estimation have the same approximate values at some time intervals and have a significant difference in some time intervals. This is due to the difference between the user’s mental model in Equation (12) and the maximum time required for trading by the e-commerce structure. In Figure 10, the relationship between the two variables TVB and time estimation has been investigated in terms of correlation.

As seen in Figure 10, at best, two variables have a nonlinear correlation with each other. This problem can be calculated implicitly in Equation (3) by calculating the formula’s dimension. What causes the correlation of these two variables to follow the specific pattern shown in Figure 10? The answer refers to disorder parameter. In a traditional business, simplified and regardless of environment and system factors, two variables TVB and time estimation, have a direct nonlinear or inverse non-linear pattern with each other.

Figure 10. Status correlation between two variables TVB and time estimation.

Model Summary and Parameter Estimates

Equation	Model Summary					Parameter Estimates		
	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.691	217.170	1	97	.000	2.078	.674	
Logarithmic	.656	184.813	1	97	.000	.624	3.121	
Quadratic	.693	108.344	2	96	.000	2.618	.440	.023
S	.594	141.818	1	97	.000	2.194	-2.324	

Figure 11. Request that their response time is more than time operations in business.

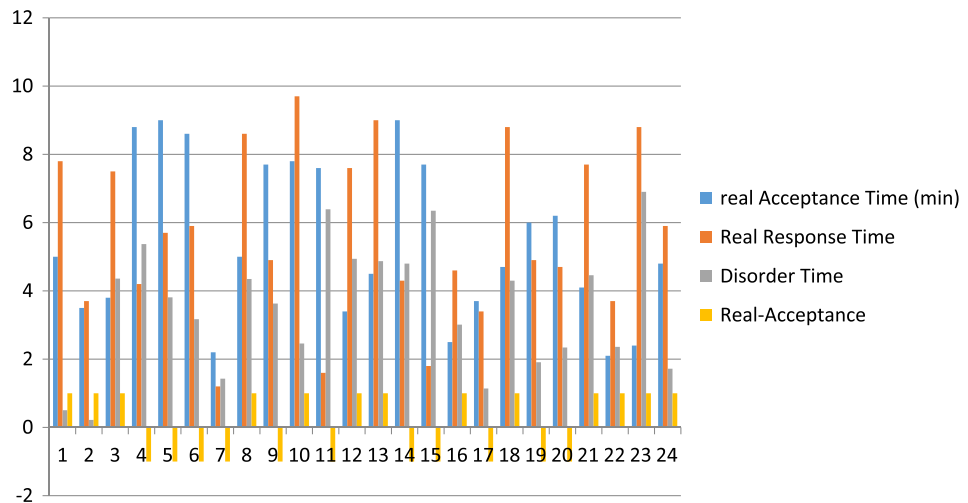


Figure 12. Correlation between test results and resulting dependency.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Real Acceptance & calculate	199	.801	.000

In this case, the customer’s mental pattern and customer response pattern in the simplest case must be in line or in conflict. However, as Figure 10 shows, this correlation exists at some time and is not considered in some other time. This is due to distortion occurring in the customer. In certain moments, for any reason, the Equation (12) related to the customer’s mental model is subject to fundamental changes. For example, an effective advertisement can change the customer’s mental model. Figure 11 represents the electronic business chart for 25 customer requests. In this graph, customer response time, actual response time, the difference between two times and nature of distortion time are displayed.

As shown in Figure 11, 11 users have been applying for trading operations in a business enterprise that the timing of the implementation of their operations by the business is beyond expectation. Therefore, trading operations have failed in their view. Using the Equations (3) and (8), the relationship between the two real-acceptance variables and the result of Equation (12) is examined in Figure 12.

As shown in Figure 12, to increase the accuracy of the test, the number of users increased from 25 to 199. The correlation between the results of the realization of the test and the result of the function of the maximum acceptable trading period has a strong correlation of 0.8 with each other.

7. Discussion

In any type of service systems, such as business systems, a concept known as the maximum acceptable time for a customer, to receive a response from the system is defined and debatable. This concept has a direct relationship with concepts such as customer loyalty, the frequency of customer presence in the business enterprise, and most importantly customer’s trust in the trading system. On the other hand, the customer has estimates based on a set of factors about maximum acceptable time to receive services from a business. In traditional trading systems, two commonly used concepts of history and importance of business for the customer are used as factors in determining maximum acceptable time.

The most important reason for using e-commerce in comparison with traditional trading systems is to solve traditional commerce challenges. In e-commerce, challenges in traditional business can

be solved using four concepts of transparency, expandability, communication with other systems and presence of a wide range of customers and businesses. The concept of transparency is one of the main tools that distributed Internet system offers to e-commerce designers; has the task of discussing and solving traditional challenges such as time and space constraints, as well as the timing of the need to meet customer and business requirements.

The existence of a set of transparency in Internet-based systems makes it possible to resolve many of challenges of location constraints in the business system. It is possible to establish a one-to-one correspondence between two concepts of establishing time transparency and maximum acceptable time for the customer. When e-commerce has the ability to establish transparency, then the customer will be kept away from the complexity of trading related activities. During the period of time transparency, the trading system tries to execute trading activities in its computing units in a way that is consistent with customer's time estimation for trading in a business enterprise. When transparency is breached in a business firm, then the customer realizes that there is a unit (or units) in the business enterprise, which is engaged in business computing activities that the customer must correct or quit in the estimate of the time of doing business. This makes time estimates of e-commerce not adapted to the customer's time estimation.

Therefore, if a firm wants to establish time transparency, it needs to use a model to estimate maximum acceptable time for a customer to carry out trading activities. An enterprise should be able to manage the key elements affecting this estimate by the client in its trading activities, after estimating the maximum acceptable time for the client, so that the estimates required for doing business in the business enterprise are within the range of the customer estimates.

An enterprise should identify the effective factors in determining the customer's estimate of the maximum acceptable time and, according to this knowledge, manage these elements in their computing units, until that the time of doing business in the business enterprise is in the range of customer's estimate.

In this paper, archway function is defined to understand the factors influencing customer's estimation. The archway function is, in fact, the function of knowing factors affecting any kind of transparency that is used in this paper on time transparency. The archway function, by examining the factors affecting trade from the customer perspective and transferring spaces affecting trade to maximum acceptable time-space, attempted to identify three technology spaces, social factors, and distortion as three main factors affecting the determination of maximum acceptable time for the customer.

Determining effective factors on the concept of maximum acceptable time for the customer has led us to have a clear understanding of the concept of time transparency. Establishing concept of transparency in an e-commerce occurs when system administrator has the ability to manage vectors **acceptable Time**_{realsociety_{vector}}, **acceptable Time**_{technology_{vector}} and **acceptable Time**_{time-Challenge_{vector}} with three mentioned conditions for time transparency. The e-commerce management for managing these vectors, uses the concept of reviewing the conduct of transaction in a process vision. A review of e-commerce based on process vision, allows for possibility of (a) discussing areas affecting B2C e-commerce. (b) To decide on what elements in the e-commerce should be made transparent.

The time transparency function presented, is a stochastic function. The reason for this is due to the nature of main constituents of e-commerce. In e-commerce, even if all parts of the system are written correctly and in light of all modes, due to the presence of the customer and human being, it is not possible to determine all possible situations and conceivable states for one occurrence in the system. The existence of a distortion variable in proposed mathematical model creates a comprehensive classification and ensures that no variables have been removed in the model. In calculating any of the variables, may not be considered some variables. The most important of these reasons is the lack of a variable in the experiments carried out to provide a mathematical model or their lack

of comprehension. In this case, aside from the stochastic disturbance in the mathematical model, it examines the status of these variables in the model.

On the other hand, the three-dimensional mapping effective on the concept of time transparency and conditions mentioned for establishing time transparency in e-commerce suggests factors that can be used to measure acceptable customer time. In order to extract and identify measurable factors constituting time transparency, e-commerce was consistently aligned with a production line system. The combination of these two systems led to the following: (a) the three elements of TNR, TVB, and Disorder as three main factors affecting time transparency. (b) The development of the Douglas function can be used to express the relationship between TNR, TVB, and Disorder.

β_1 , in an actual environment, can cover many other variables such as costs of technologies paid by the customer and the business to create the actual environment of e-commerce and time costs of creation, start-up, and maintenance of an e-commerce environment. β_2 and β_3 represent the tension between “TNR” and “TVB.”

The rate of partial tension shows the amount of influence that these two variables, as fundamental variables and effective variables on spent time, get from the environment. The amount of partial tension actually means that how a general change in the status of the generator vector of each input element affects the generator vector of another input element. Mutual influence of these leads the system to keep its current transparent or to deny transparency.

The reason for this is that if the time of doing business in a single unit of e-commerce assumed to be influenced by two factors of non-technology and technology, and then each increase will be a change in response time to request. Time transparency function reflects the direct impact of using technology in e-commerce. If the maximum productive space for traditional and electronic trading systems is re-examined, I turn out that the TNR, TVB and even the disorder in e-commerce are directly affected by the technologies that e-commerce uses to reduce response times.

The time transparency function and experiments carried out suggest that maximum acceptable time for the customer, in addition to the direct impact of the concept of technology, is also non-linearly affected by this space. This is due to the customer’s psychological sense. The psychological sense of using technology makes it possible for customer estimates to be less about the time it takes to trade in e-commerce than traditional trading systems.

The time transparency function and necessary conditions for management of triple vectors that affect the time transparency suggest that customer in a business firm will notice a breach of time transparency in two situations. The first situation is dependent on the e-commerce. In this situation, the execution time of the operation is different from the conventional time of the operation. In this case, the customer realizes that there is a factor in the process of executing current operation within a system that has not existed in user’s regular operations, and has caused a breach of time transparency. The latter is when the process of responding to user requests, by any factor, varies from the time perspective. In this state, middle positions are defined that did not exist in user’s usual performances. Usually, increasing the number of hosts to the company’s agent creates a new status called Waiting, which in the past performances, from the view of time; the system user did not enter such a situation.

On the other hand, the use of the time transparency function in the IBM B2C business suggests that in models where the end user has on one side (like the B2C pattern); the request in business is formed at the point of time $-\infty$. In each point of time along the time axis, the request may have been formed by a customer. Request formation by a customer means activation of the e-commerce. The occurrence of occurrences in the system is measured at this time. If the customer’s views are in line with what they expect, the system is transparent, otherwise, it is not. Therefore, the time to perform the operation in the relative system is dependent on the user’s time. In an e-commerce such as IBM B2C,

if the time does not reduce the maximum acceptable time for the user in the points where the factors affecting time appear, by sub-systems that increase the speed of execution, transparency is violated.

8. Summary

The maximum acceptable time for the client, if the business firm ignores it, will cause challenges in business or in continuing it. This paper, by examining the concept of acceptable customer time and its effective factors, describes the relationship of factors based on mathematical functions. This will allow the business firm to be able to decide in a parametric manner about any factors that would be in violation of acceptable time for the customer. The customer directly relates this time to concepts such as customer confidence, loyalty, and the sense of using technology, and its results can be found in research on customer behavior in a business enterprise or the impact of time on factors affecting business such as loyalty, frequency of referral to the commercial firm and, above all, satisfaction.

Funding

The authors received no direct funding for this research.

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Citation information

Cite this article as: Artemis time: A mathematical model to calculate maximum acceptable waiting time in B2C e-commerce, Ehsan Mousavi Khaneghah, Nosratollah Shadnosh & Amin Salem, *Cogent Business & Management* (2017), 4: 1405509.

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