DR. ABBAS SHAHIM RE IS PARTNER AT ATOS CONSULTING, ASSOCIATE PROFESSOR AT THE UNIVERSITY OF AMSTERDAM AND VICE PRESIDENT OF ISACA NETHERLANDS CHAPTER

REAL-TIME INFORMATION FACTORY: A HIGH-LEVEL LOGISTICAL GRC FRAMEWORK

1. INTRODUCTION

Today, it is rather challenging and almost impossible to notify critical business partners and demanding clients that they cannot gain access to live data held on different systems and stored in varied formats whenever and wherever it is desired. This is quite hard to explain as they perceive that information technology (IT)[1] continues to speed up their day-to-day work (e.g. an agent obtaining an in-depth view of a client from multiple data sources during the current call). In addition, they are completely aware that this evolving industry has advanced to the point that it enables organizations to switch from the traditional batch-oriented approach[2] to the sophisticated real-time[3] techniques so that the principle of dated data can be considered as history. This need largely reflects an operational character corresponding with the core activities (hereinafter referred to as primary processes[4]) and is also applicable to the way in which data[5] and information[6] (hereinafter referred to these terms as information) delivery solutions are deployed within organizations for support and management purposes (hereinafter referred to as secondary processes). The actual information is essential for executing these daily tasks and for taking well-informed decisions at operational, tactical and/or strategic levels (e.g. analyzing the delivery chain in a short-cycle segment for which the detailed information immediately retrieved from various solutions is passed directly to a

1 IT is defined as the hardware, software, communications and other facilities used to input, store, process, transmit and output data in whatever form (ITGI, 2007).
2 Batch-oriented approach represents a sequentially dominated mode of processing. In batch, input is collected and stored for later processing. Once collected, the batch input is transacted sequentially against one or more databases (Inmon et al, 1998).
3 Real-time is the terminology that is usually used in computing to describe the time-critical aspects. It simply refers to a timeframe that is very brief, appearing to be immediate. When a system processes data in real time, it reads and handles data as it is received, producing results without delay (Madison, 2009).
4 In this article, primary processes also include the so-called guiding processes referring in general to organizational rules and instructions for delivery of the products and services.
5 Data is made up of measurements and observations and can be perceived as a recording of facts, concepts or instructions (Bodenstab, 1997 – see also Inmon et al, 2000).
6 Information results when data is processed to extract particular items that focus our attention and trigger a specific reaction. This reaction may be active – changing a procedure or asking a particular employee about a certain account – or it may be more passive, in that we add it to our body of knowledge for future use. Information is thus what human beings assimilate and evaluate to solve a problem or make a decision (Bodenstab, 1997 – see also Inmon et al, 2000).

Business Intelligence (BI)[7] facility) to be a sustainable winner in this competitive and turbulent information society. In fact, it can be stated that IT has also played an essential role in developing this real-time requirement mainly as a result of the progressive conveniences (e.g. online banking) that this intriguing technology has brought to the current ever-more changing and complex marketplace.

As organizations strive to balance volatile shift in external factors (e.g. business environments and clients' expectations) and optimize their processes, the adoption of a proper and value-adding technology has become vital to meet the arisen real-time demand and consequently reach more success. Many of them perfectly realize the significance of this undertaking and intend to follow this irreversible philosophy to the possible extent to maximize their profitability. Therefore, the timely receptiveness is currently seen as a key and decisive factor for organizations to survive in this eventful, somehow unpredictable and digital economy. They are fully cognizant of the fact that reacting with speed to the future real-time world necessitates insight and agility, and are ascertained that their competitors have also come to the same conclusion. Hence, most of them are willing to revamp and some have already started highly appreciable initiatives to enable a (near-) immediate primary and secondary processes. The main motive behind this promising movement is the capability to instantly react to business or market changes for which fresh information is an implicit requirement. It is quite clear that the added value of information is extremely correlated to the timeframe within which it is available for use. Due to the persistently increasing possibilities provided by IT, it is thus made easier to drag the lags and latencies out of the organizations and pave the time-based road in this manner to operate more effectively and efficiently than ever before. This modern and major objective also calls for a cohesive framework that interlinks Governance[8], Risk[9] and Compliance[10] (GRC)[11] aspects of the growing real-time need. In relation therewith, the whole leading idea here is to, where possible, explore and early anticipate on the impact of these upcoming and crucial topics that have already attracted the attention of many top executives working in different fields and domains.

---

7 BI represents those systems that help companies understand what makes the wheels of the corporation turn and to help predict the future impact of current decisions. These systems usually based on the datawarehousing concept place a key role in strategic planning process of the corporation. Systems that exemplify BI include customer profiling and contact analysis, market segmentation, product profitability, and inventory movement (Inmon et al, 1998).

8 Governance is defined as the procedures utilized by the representatives of the organization's stakeholders to provide oversight of risks and control processes administered by management (Sawyer et al, 2005).

9 Risk is defined as the uncertainty of an event occurring that could have an impact on the achievement of objectives. Risk is measured in terms of consequences and likelihood (Sawyer et al, 2005).

10 Compliance is the ability to reasonably ensure conformity and adherence to contracts, organization policies, plans, procedures, and laws and regulations (Sawyer et al, 2005).

11 GRC is not described here from a greatly theoretical, package-based or tooling point of view. This article possesses an explorative nature in particular and therefore discusses the topic from a general, basic and broad perspective.

The present article set out to present a high-level view inspired from logistics that adds a possibly realistic dimension to the speedy and progressive information chains and their associated GRC approaches. This new line of thought establishes the central context, positions the first scope, lays the primary ground for further study and provides elementary frameworks that can serve as starting points for specific controlling discussions particularly concerned with the design and implementation of those two topics. It also defines some core components that can evolve into a pragmatic and helpful managerial instrument to steer in the proper direction. The article is hence structured as follows. Section 2 demonstrates the main idea behind an exemplary real-time facility, and globally explains its layers and their functions. An overall concept of supply chain and a separate view on the way in which it is controlled along with some pertinent aspects in reference to the real-time information factory are described in section 3. Based on this prominent logistical philosophy, section 4 proposes an initial and generic GRC framework for the architectural capability shortly mentioned above that logically consists of three chief components. In the last section of this article, our closing remarks with respect to GRC as an essential business challenge are presented.

2. WHAT IS THE REAL-TIME INFORMATION FACTORY?

The aforementioned briefly indicates the pervasive influence that time exerts on business in this fast-paced mondial economy, and clearly generates the sense that time accelerates towards instantaneity. Accordingly, organizations have come to the realization that they should at least better leverage technology to drastically decrease the time needed to access the desired and actionable information, and get it in the hands of the concerned resources in time to satisfy the clients' demands and wishes. Nowadays, this fundamental aspect is not only an issue for the airlines offering online booking systems to passengers or for the financial service providers using real-time processes to check for credit card fraud, but also is a challenge for other speedy and complex industries. A peculiar example is the manufacturing sector that requires quick actions and decisions with respect to various occurring events such as a supplier that do not meet the formalized delivery agreements. Obviously, conducting business in this real-time manner also involves a highly modern and advanced IT environment. It appropriately enables innovation and adequately supports leaps in productivity by placing the main focus on rapid providing of information to and fast sharing of this valuable asset with more users. In a forthwith fashion, this sophisticated solution based on the trigger-response[12] principle facilitates the acquisition of different types of information (e.g. sales information and market trends) from varied systems, creates the possibility to make it ready for use, and ensures the delivery of this finished

12 Trigger-response signifies that the information necessary to satisfy the wishes and demands of users is assembled on-line from the accessible sources, and is delivered to users with no delay in response to the initiated request.

product to a wide range of users (e.g. applications and users) to fulfill their tasks (e.g. handling orders and selecting product-market combinations).

Throughout the rest of this article, we refer to the integrated provision chain concisely discussed above as real-time information factory that is conceptualized in figure 1. This simplified visualization is used here as a high-level example to shortly expound the architectural concept of this layered environment and to succinctly describe the way in which it functions. Various consumers including operational systems and end users supporting and fulfilling primary processes, or executive reporting processes[13] and managers facilitating and carrying out secondary processes, initiate a request to satisfy their information needs. This real-time trigger is captured straightaway by a live mechanism and is sent immediately to multiple data sources such as On-Line Transaction Processing (OLTP)[14] systems, data warehouses[15], databases[16] and spreadsheets[17]. The current information obtained from these capabilities is directly processed which in addition goes through a transformation consistent with the pre-defined logics and rules if necessary to finalize the fabrication. Without any delay, this produced information is either prepared by an engine to be used for primary processes by the initiator itself and/or by other consumers such as transactional systems and employees, or undergoes an aggregation[18] to be set for performing the secondary processes by the initiator itself, accounting processes and/or executives. This provision to various users according to the requirements is in fact the response to the submitted request (i.e. trigger). In other words, the real-time information factory depends on the demand and is an interrelated solution that instantaneously enables the obtainment of any kind of information regardless of its location and format, ascertains its entire fabrication and assures its provision through the indicated channels intended for both the primary and secondary processes with either an internal and/or external orientation. This highly progressive environment links and integrates these three central processes (i.e. obtainment, fabrication and provision) with various users and multiple data sources, and directly acts on triggers to immediately supply the information requested for fulfilling diverse needs. Generally, it thus serves as an assembly of the following six main layers numbered in the figure below:

> Users initiating triggers to satisfy their own demands and wishes and/or those of others.

13 An executive reporting process generally focuses on providing standard reports to executives that present specific information, often in line with an enterprise hierarchy and overall goals (Hammergren, 1996).
14 OLTP represent a computer application that automates one or more business processes such as order entry (Hackney, 1997).
15 Data warehouse is defined as a collection of integrated and subject-oriented storerooms designed to support the decision-support-system function, where each unit of data is relevant to some moment in time. The data warehouse contains atomic data and lightly summarized data (Inmon et al, 1997).
16 Database is a collection of interrelated data stored (often with controlled, limited redundancy) according to a scheme. A database can serve single or multiple applications (Inmon et al, 1997).
17 Spreadsheet is a computer application that allows for the easy manipulation of numerical calculations. It is also referred to as an analytical tool for individual decision support analysis (Hackney, 1997 – see also Inmon et al, 2000).
18 Aggregation is defined as gathering into a mass, sum, or whole. It refers to the concept of rolling up information within the defined hierarchy (Hammergren, 1996).

> Live mechanism capturing those real-time requests.
> Data sources layer housing different types of information.
> Obtainment layer extracting the required information from the available sources.
> Fabrication layer processing and transforming those extracts.
> Provision layer distributing the response in conformity with the agreements.

In summary, it can be stated that the real-time information factory possesses the potential to dynamically assist primary as well as secondary processes within organizations in many ways such as supporting action taking and monitoring activities. This architected and achievable facility handles a flow through and immediate mechanism that can help many of them to act responsive in today's bumpy economy. They gain additional competitive advantage as business management can greatly be improved by virtue of the real-time information provision to every part of organizations including supply chain. Among other users, executives and managers are then enabled to view the present status of the flow of goods and money, and are given the opportunity to navigate and adjust if necessary (Tanate, 2009).

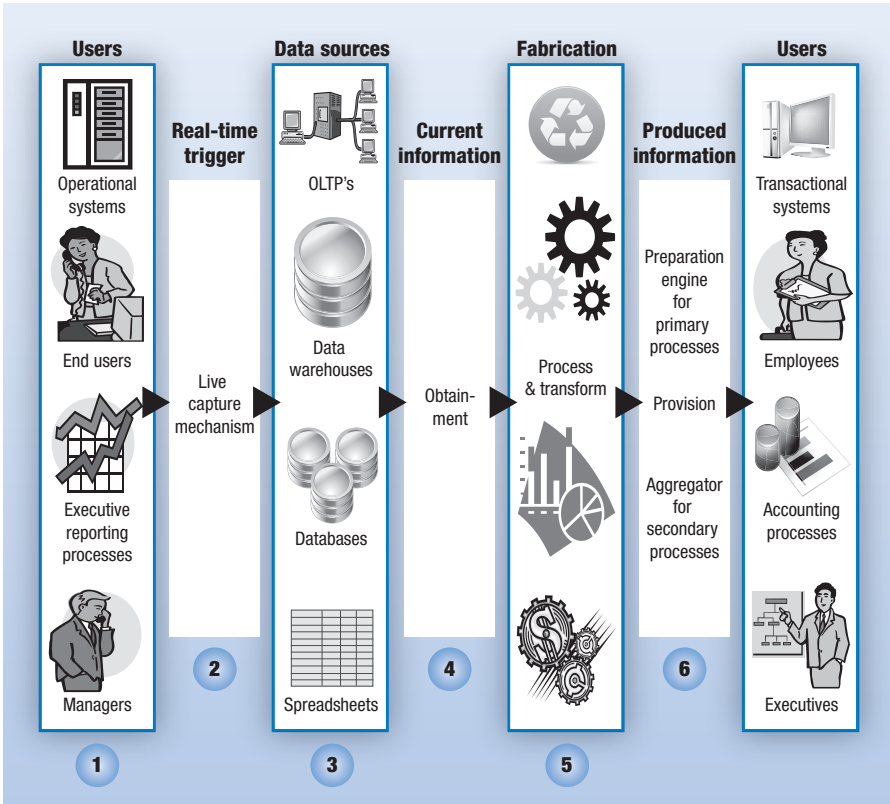

Figure 1: An architectural concept of the real-time information factory

3. AN OVERALL SUPPLY CHAIN AND GRC PERSPECTIVE

The usage of valuable experience gained by and the application of helpful frameworks developed by old industries are currently more often found necessary and desirable to benefit from the lessons learned by these reverent disciplines. The rationale behind this goal is to mainly strengthen the knowledge, sharpen the insight and feed the wisdom so that value adding and solid possibilities are created more readily for other sectors and are advantageously utilized by them. It is based on the belief that deploying the identical elementary concepts of the distinguished industries can generally result in the same stable level of maturity, lasting power and reliability as already proved in practice (e.g. quality machinery in the engineering segment). For instance, the architecture[19] of an IT solution is normally described by using instances from the construction discipline. A house is the classical example that is mostly mentioned to explain the importance and significance of architecture before any other construction activity takes place. Logistics[20] is also a noted industry with a fascinating and rich history that has designed and implemented many interesting frameworks and pragmatic models that have successfully been put into operation. The principle of factory management[21] is a typical example that is used to organize and run large scale software development activities in favor of achieving customer satisfaction and continuous refinement in conformance with a more proven, structured and manageable manner.

Viewing the general idea of the real-time information factory from a basic logistical perspective closely resembles the way in which the flow of raw materials, goods and services (hereinafter also referred to as inventory) is arranged in this comprehensive world to satisfy the market demands and needs. Concretely, the layered environment expounded above shows similarities with the overall perception of supply chain management (SCM)[22]. In an optimized fashion, this perspective integrates the processes from clients through suppliers and describes the series of successive acts that are necessary to meet the specific and generic desires and wishes of those customers. In general, it can be said that these users originally initiate demand signals like in our architectural concept. On receipt, this activated trigger is analyzed and

19 Architecture can simply be explained as a set of components, rules, structures and layers providing a framework for the overall design of a system or product (Poe, 1996).

20 See Christopher, 1992 for a detailed explanation – see also Ballou, 1992.

21 Factory management normally places emphasis on the improvement of operations which is the primary source of creating value for customers. It pertains to a wide range of activities (e.g. managing short product life cycle, evaluating alternatives to mitigate risks and minimizing liability) aimed at achieving lean operations and enhancing performance.

22 The Supply Chain Council defines SCM as (Francis, 2008): a group of processes (not organizations or functions) which span interactions with suppliers up to interactions with customers primarily focused on fulfillment of the customer order. Essentially wherever there are materials or services flowing to an end customer (or from a customer in a return cycle), the processes involved are supply chain processes. There is interaction with suppliers for product design, but that does not involve material flows to end customers. There is interaction with customers for sales to support the selection of materials and services, but it does not directly involve flow of materials to end customers.

sent to the suppliers after which the procurement activities are started to acquire the requisites. This obtainment process on these sources leads to the movement of the inventory to manufacturing support that normally consists of many activities such as planning, scheduling, and assisting production operations. The finished products as the result of this fabrication process then flow through the rest of the chain and are ready to be physically distributed to clients who ordered them. This provision either prepared directly or after a slight transformation in conformity with a defined structure, is in fact the final part ensuring that their requirements are satisfied in accordance with the predetermined agreements. It can thus be argued that the overall supply chain management portrayed in figure 2 is a sophisticated principle that also holds six main components (i.e. layers) comparable to those included in the real-time information factory as numbered in figure 1. This logistical approach presents the focus on integrated management of the operations from original supplier purchase to final client acceptance. It shifts these activities from a loosely connected category of activities to a coordinated process that is aimed to acquire efficiency enhancement and to gain increased competitiveness (Bowersox and Closs, 1996 – see also Burt et al, 2003).

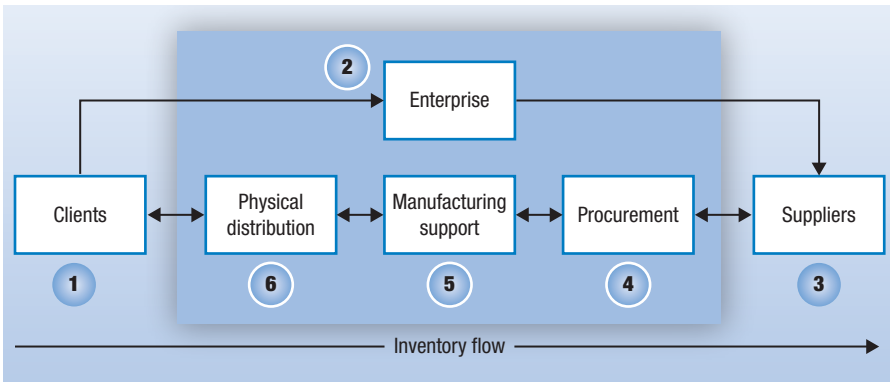

Figure 2: Overall supply chain management (Bowersox and Closs, 1996, p. 101)

Supply chain management thus integrates the logistical operations and extends their behavior to incorporate clients and suppliers. Each of its participants executes a sequence of value adding tasks and produce ordered and ready-to-use products or services that are finally purchased by the clients (Burt et al, 2003). We can get inspiration from the ways in which these activities are governed in dependent demand[23] situations, the associated risks are treated, and compliance requirements are met as briefly discussed below to help establish a certain image of them. Due to its similarity with supply chain point of view, the real-time information factory

23 The term dependent demand signifies that demand for material and component requirements in a time-based environment is dependent on demand for finished goods. In other words, the amount of materials and components going into a production facility depends on the amount of finished products expected to come out of that facility (Bowersox and Closs, 1996, p. 489).

can utilize this insight as a highly useful and relevant input so that it attains the same practical effect and durable outcome as already realized by those time-based environments.

3.1 Governance approach

Tow main approaches are chiefly explained in the literature that can be applied to govern an implemented time-based logistical environment using a flexible style: Requirements Planning (RP) and Just-In-Time (JIT). These techniques depicted in figure 3 are intended to coordinate the arrival of the accurate inventory required to meet a planned event and possess their own unique characteristics and capabilities. The most globally known methods as part of the first governance approach (i.e. RP) are Material Requirements Planning (MRP) and Distribution Requirements Planning (DRP) both concerned with managing inventory resources. The former one is peculiarly deployed for inbound material movements, and the latter method representatively points at forward assigning of ready-made products in the distribution channel. In the context of the RP model, participants in the chain place an order consistent with clients' needs. JIT is the second governance approach which is the initial famous technique to time-based logistics introduced by Japanese in the 1950s when Toyota Motor Company[24] positioned the famous Kanban[25] system. This philosophy confines the purchasing of materials and goods, and limits the production of products to the precise numbers that are necessary to accomplish the specified work. The JIT perspective solely allows the movement of components in the exact amount, at the exact time, and in the exact locations where they are requested. No more, nor less. In other words, the essence of this concept is that demand for the products only depends on the required production schedule (Bowersox and Closs, 1996 – see also Burt et al, 2003).

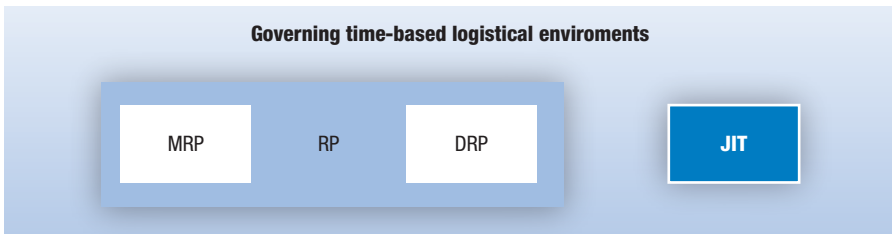

Figure 3: Two main governance approaches in supply chain

In the context of demand dependent situations, the aforesaid is also referred to as JIT supply chain. It implies in fact a time-based environment including internal functions

24 See http://www.toyota.co.jp/en for an introduction.

25 A kanban system can also be called a "pull" system. In a pull system, units needed by an upstream stage of production are transported to that stage only when needed and in the exact amount needed. This is in contrast to traditional "push" production systems in which units are transported to the next stage as soon as they have completed the previous stage (Burt et al, 2003, p. 129).

and external suppliers involved in the identification and satisfaction of clients' needs and demands. Although both governance models succinctly described above fit the purpose, we strongly believe that JIT supply chain better corresponds to the rationale behind the real-time information factory which is further argued below. Hence, this interesting logistical concept is used as a reference throughout the rest of this article to be as specific as possible.

3.2 Risk management approach

Nowadays, many organizations have truly experienced that being successful also takes an adequate enterprise risk management[26] approach. For this essential purpose, top professionals are usually assigned the task to develop better understanding and means of dealing with risks that disrupt the proper working of the JIT supply chain. Here, our discussion with respect to risk management in this modern perspective is restricted to only three pertinent risk prone areas expounded in the literature that are summarized in figure 4. The idea is to help create a certain image of some main aspects that require tailored mitigation focus in addition to others such as finance, laws and regulations. Risks associated therewith should be identified, analyzed, evaluated and treated in the established context as they can negatively influence the correct functioning of the JIT supply chain and consequently form a threat for reaching its operational objectives. The first area pertains to sourcing that aims at strategically supporting the goals of this logistical philosophy. It considers the traditional standards including the low-cost and quality products delivering suppliers as given and emphasizes a distinct mindset indicating that their selection should notably be based on specific criteria to serve the operation more appropriately. Risks in JIT-capable sourcing can especially be involved in two main factors: special agreements (e.g. consignment inventory[27] and establishing pull systems with suppliers to order materials) and suppliers selection (e.g. on the basis of their geography so that materials can be combined to effectively leverage logistics spending). The second area is production planning that starts in this logistical concept with the so-called lean/flow-based production. It is a process that reduces the time necessary for materials to go through the production activities from start to finish. Components and products thus spend a minimal amount of time in work-in-progress inventory queues and storerooms. Risks in a JIT production planning can mainly be coupled with the following aspects: process capability (i.e. the relative difficulty of changeover from one particular goods to another), process flexibility (i.e. possibility of an easy and frequent cross-section of all products), and demand-based system (i.e. deploying a pull system to reorder or move materials). The last

26 Enterprise risk management deals with risks and opportunities affecting value creation or preservation. It is defined as a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives (COSO, 2004).

27 Consignment inventory is that which is in the possession of the customer, but is still owned by the supplier (Harmon, 1993).

area concerns the transportation in an unbundled manner which is necessary in the JIT supply chain as smaller amounts of materials are moved frequently. In this case, the transportation solutions are untied using third-party logistics providers or consolidators[28]. In such environments, risks can particularly be connected with transportation network for which either owned or leased transportation assets can be used (Larson, 2005).

Figure 4: Three risk prone areas in JIT supply chain

3.3 Compliance approach

In the present networked marketplace, compliance is often perceived as one of the main challenges that many organizations encounter in the battle for getting new business and retaining acquired engagements. The importance of this theme in the JIT supply chain is underlined as clients mostly demand back-end compliance and accordingly place associated requirements on suppliers to meet their own desires and wishes. It is hence essential in such environments to possess a vivid understanding of these complex needs, and develop an aligned process to satisfy them precisely. For this crucial purpose, it is now quite common that organizations have a customized compliance program in place that in general comprises of accepted industry standards as well as predefined deviations for fixed customers. Our discussion with respect to the aforementioned topic is here limited to three usual examples illustrated in figure 5 to help establish a certain image of a few related aspects. The first one pertains to fulfilling the compliance rules stated in the formalized business contracts between the trading parties. It can be indicated therein that the communication on product deliveries in the chain is based on the widely recognized standards. This hard compliance requirement mainly includes Electronic Data Interchange (EDI), bar coding and Radio Frequency Identification (RFID)[29]. They serve as a standardized foundation as well as an elemental building block aimed at transmitting shipment information in a predetermined format to electronically present corresponding details such as items and quantities. The second aspect concerns conformity and adherence demands with major impact

28 Consolidators convert the smaller loads of various customers into a single shipment to achieve the economies of scale (Ackerman, 1994).
29 See Jilovec, 2004 for an extensive description that also explains EDI and bar coding.

on internal operations for which, at least, organizational rules, plans, procedures and instructions are necessary. One such compliance desire is the so-called Direct Store Distribution Center (DSDC) that calls for suppliers to execute orders on a store specific basis. It simply implies that an order received from a client is intended for multiple stores as a result of which individual pallets are made available for each of these destinations. In this concept, the concerned client thus entirely removes the handling of these activities and puts the work back on the involved supplier to which it is presumed to be committed (Carlson, 2005 – see also Korolishin, 2006). The last aspect deals with the compliance requirements with regard to legislations which can normally vary in different countries and industries. Representative examples are respectively the customs clearance and the European directive on the Restriction of Hazardous Substances (RoHS also known as directive 2002/95/EC)[30]. The former one is for instance mandatory for goods that enter and leave the European Union. Customs clearance is the process to account for any charges due and to check for documentation and conformity with the regulations and the European Union law. RoHS (i.e. the latter example) holds electrical and electronic equipment organizations directly responsible for the chemical compliance of their products. Concretely, this legislation signifies that these manufacturers must ascertain that their goods, parts and components comply to be distributed and sold in the European Union (EC, 2008).

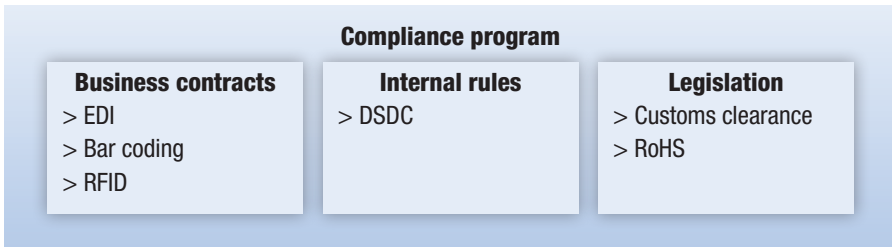

Figure 5: A few compliance aspects in JIT supply chain

4. A HIGH-LEVEL LOGISTICAL GRC FRAMEWORK FOR THE REAL-TIME INFORMATION FACTORY

Currently, supply chain is seen as a true strategic philosophy due to its laudable acceleration across the globe in the last few years. Organizations being part of this logistical network chiefly place emphasis on enhancing their responsiveness, applying leading practices and deploying advanced solutions. They directly share actual information with their mondial suppliers and clients, and frequently seek for early partnership with the parties in the chain to introduce new products and services faster than ever before. As a result, the intensive and formal cooperation with the global business partners in an instantaneous fashion is recognized to be

30 See http://ec.europa.eu/environment/waste/weee/index_en.htm for further information.

an essential capability. Many organizations are moving towards a real-time supply chain supported by computerized solutions that smoothly provide live information to involved participants. The adequate management of such worldwide JIT and on-demand environment with the increasing role of IT has therefore become another vital competency, and is considered as a must to succeed in the tomorrow's fastidious world (Pataro, 2006). As the basic ideas of this modern logistical concept and the real-time information factory are quite the same (i.e. they both deliver on request in a timely manner for which only that inventory flows through the chain precisely needed to carry out the job), mapping of the GRC principles discussed above to our dynamic facility can contribute to enhance the way in which it is organized and managed. By drawing lessons from those significant guidelines, relevant and valuable inputs are generated that can readily be used to develop and implement a pragmatic and oriented framework. This high-level and configurable context based on logistical models creates the possibility to more effectively and efficiently govern real-time information factories, mitigate the associated risks and comply with any applicable requirements with various natures and characteristics. The framework proposed below can assist most organizations in improving many GRC related aspects. Among other things, they are concerned with upgrading the disciplines, terminologies, methods and structures, enabling the appropriate leverage of inherent interdependencies of processes, removing duplications and complexities which is often the result of diverse IT systems, and minimizing administration efforts. An initial attempt is made below to concisely demonstrate the primary elements of the above-mentioned projection.

4.1 Governance approach

In comparison with the RP model, it is our belief that the popular JIT concept better matches with the rationale behind the real-time information factory as previously indicated for which we present the next three main argumentations. It should be noted that they are not limitative and are intended to justify the choice of the governance structure in this article. The first argumentation demonstrates the potential, widespread adoption and the proven added-value of the latter logistical philosophy (i.e. JIT) reasonably ensuring that a useable and steady approach is applied for the adequate governance of the aforesaid architected solution. It can be a strategic source of competitive advantage when applied aptly which is indeed what our dynamic environment also strives to effectuate. The second argumentation pertains to the most fundamental characteristic of the JIT model dictating that the required inventory is that which is necessary to accomplish the task. This storage-free[31] feature corresponds with the essential peculiarity of the real-time information factory as no information (i.e. inventory) is also lastingly housed therein. The closer organizations thus get to the JIT concept, the more responsive they become to

31 In the IT context, storage-free implies that information is merely saved in the available data sources permanently.

their clients which is one of the highly important motives for this forthwith facility. The third and last argumentation is concerned with the simple fact that there is obviously a concept called JIT supply chain as repeatedly referred to above. It is successfully implemented and utilized on which different available commercial product types (e.g. Operational Business Intelligence (OBI)[32] that in fact imitate the main idea of JIT to retrieve the required information in a (near) real-time fashion) are based that are also helpful to build and operate our progressive capability.

4.2 Risk management approach

A high-level mapping of the three above-describes risk prone areas along with the indicated examples to the real-time information factory (see also figure 1) leads to the following. The first area is sourcing that mainly pertains to suppliers for strategic purposes. It considerably corresponds with trigger capture mechanism, data sources and obtainment process. Special agreements risks can be involved in consignment inventory and establishing pull systems with suppliers as previously discussed. In the event of the real-time information factory, this signifies that risk management pays substantial attention to elements which are harmful to catching a live trigger and impair the immediate extraction of the necessary current information either from a separate storages made available within the specific domain of data sources or from accessible systems in operation. Supplier's selection risks can be connected with their geography (so that materials can be combined to effectively leverage logistics spending). This implies that risk management for our advanced capability concentrates on threats attached to the locations of the approachable data sources in use to be essentially picked for obtainment purposes. The second area relates to production planning that is in fact about the lean/flow based production. It is quite similar to the way in which the fabrication process is carried out in this proposed solution. As already presented, process capability risks can be associated with the relative difficulty of changeover from one specific goods to another. This means that risk management for our flow through facility focuses on threats that impact its ability to adequately handle the actual information needs and properly switch from one information demand submitted by a user to another information desires initiated by others. Process flexibility risks can be enclosed in the possibility of an easy and frequent cross-section of all products. For the real-time information factory, this signifies that risk management stresses the aspects putting its capability in danger to correctly execute large batches of different information wishes and also instantaneously run varying information requests in a suitable manner. Demand-based system risks can be coupled with deploying a material pull system. This implies that risk management for our zero inventory[33] environment places emphasis on factors which are damaging to its ability to directly resend triggers (i.e. real-time demand signals for information provision) and to timely move the required

32 See Manley, 2005 for an extensive description – see also Power, 2009.
33 Zero inventory and storage-free are interchangeable and synonymous terms in this article.

information inventory throughout the entire fabrication process in an appropriate fashion. The third and last area is concerned with unbundled transportation. It most closely matches the way in which the provision process is performed. As mentioned above, transportation network risks can be linked to owned or leased transportation assets that are used. This means that risk management for the real-time information factory focuses on aspects that negatively exert influence on its ability to aggregate or prepare the produced information for provision to users for which either owned products and services or those of third parties are utilized.

4.3 Compliance approach

Compliance obligations pressurize organizations around the world and influence various important areas including IT. Its compliance related issues are getting more complicated and are not only driven by standards and legislations, but also by the new technologies increasing the complexity of computing. Many organizations therefore search for a structured approach and strive to construct and implement a sustainable IT compliance program. Among other essential aspects, it should enable them to develop a tailored context, identify objectives, define and prioritize controls, and establish a record system to be effective and respond robustly to the current dynamic business climate. The general projection of the above-discussed examples associated with this interesting theme to the real-time information factory shows in fact the integration of three main compliance categories (Vaassen, 2007): commercial compliance, organizational compliance and regulatory compliance. As already mentioned, the first one pertains to the made business arrangements stated in formally agreed-upon and signed-off business management documents. This has a generic impact on nearly all layers of our architected concept (see Figure 1) and signifies that it contains adequate controls (e.g. for supporting the standard electronic format correctly) and record systems (e.g. proper registration of exchanged invoices) to satisfy the common requirements of EDI, bar coding and RFID for communication with involved trading parties, and accordingly synchronize the supply chain. The second category is concerned with the enforced internal rules as previously indicated. This also means that the layers of the real-time information factory possess the ability to ascertain adherence to compulsory specifications of DSDC that especially affects the provision layer delivering to multiple users (i.e. store specific basis). The third and last category relates to laws and regulations which can be diverse in different countries and industries as already described. Like other two classifications, this implies that our advanced capability embeds appropriate controls and record systems in almost every layer to meet the particular demands of customs clearance and RoHS (e.g. respectively supplying the necessary information and/or certificates allowing customs authorities to control goods, and delivering one certificate or declaration as evidence of compliance for each class or type of electrical or electronic component).

4.4 Logistical GRC framework as a whole

The introduced logistical GRC framework assembles three growing and important areas of focus inspired from the long lasting logistical principles that can highly aid the real-time information factory in providing expanded value if applied properly. It contributes to breaking down the traditional barriers between governance, risk and compliance, and interconnects these essential components to simplify the complex requirements of today's GRC environments. The presented framework serves as a dome and coordinating context addressing the key aspects that are helpful for constructing a well-planned and responsive approach. It can assist in showing greater transparency, mitigating the mounting risks, meeting various complicated demands with various natures and characteristics, and accordingly paves the path towards an integrated view on these crucial factors. The suggested framework takes JIT supply chain as a steady and proven logistical concept to bring leading clearness in the governance of the real-time information factory, guides to deal with risks related to the identified risk prone areas (i.e. sourcing, production planning, and transportation) in this modern logistical philosophy corresponding to real-time trigger capture mechanism, data sources, obtainment process, fabrication process, and provision process, and helps in satisfying the concerned and relevant requirements associated therewith categorized as commercial compliance, organizational compliance and regulatory compliance that affect the layers of our flow through solution expounded above. It should be noted that we do not proclaim the proposed framework graphically outlined in figure 6 to be definite, complete, mature, impeccable or fully aligned with the leading practices in the field of logistics, GRC and real-time information chains. It is neither an automated controlling facility nor a monitoring instrument yet, and is just the result of a simple comparison expounded above that is based on the knowledge gained and lessons learned by logistics throughout the years. The new idea inspired from this lasting industry with a rich history should certainly be seen as a high-level framework that initially intends to show the context, demonstrate relations and deliver an integrated insight. Additional research and further development are obviously required to detail its interdependent components and to support a broader acceptance prior to its final deployment.

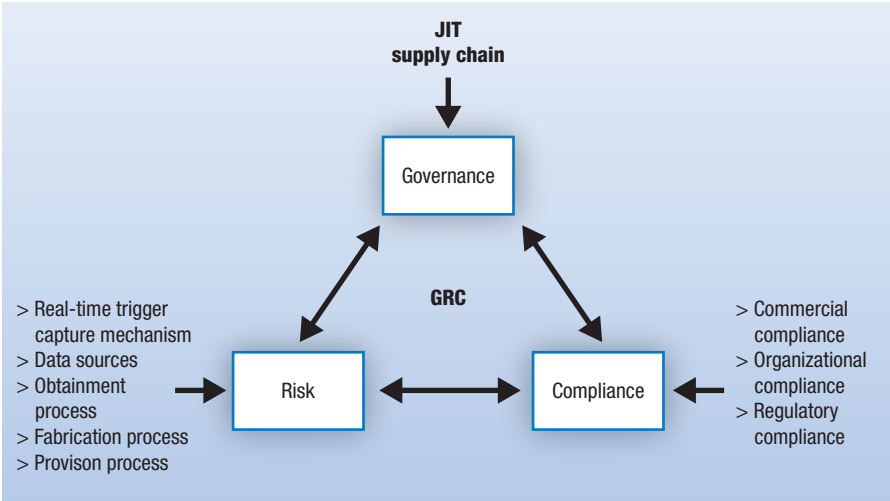

Figure 6: A high-level logistical GRC framework for the real-time information factory

5. CLOSING REMARKS

As the economy is undergoing enormous upheaval and the pace of globalization quickens, many organizations across an array of segments have already noticed that the shape of the overall marketplace is rapidly changing. Many of them consider a migration to real-time business management to timely respond on clients' demands and reap a number of commercial benefits. They perform activities to improve their understanding of the timeously way of working and develop pragmatic competencies to enable its proper application in the workplace. Organizations thus strive to outpace the competition by restructuring their processes and underlying solutions, and are entirely aware that business agility requires the capability as well as capacity to act in time for which live information is of great importance. For this fundamental purpose, they have also applied IT as this tremendous technology continues to evolve and offers a number of improved and sophisticated possibilities. These interesting and advanced opportunities can justifiably be leveraged to lay the ground for a sound and transparent real-time information factory aimed at instantaneously facilitating primary and secondary processes. In addition, it definitely needs a correlated GRC approach that has recently come as a hot topic to the forefront of attention in the today's mondial and stormy world. This emerging and impressive concept is perceived valuable to responsive organizations and will be a major emphasis for them to particularly safeguard their continuity. They need to adopt a leading governance structure, face the incessant push for the usage of proven risk management practices, and are stressed to meet stricter compliance requirements.

Therefore, GRC is becoming a criterion for management adequacy, stabilization and recognition for many organizations especially those that deal with time-related business issues and must therefore heavily focus on the speed of their processes to convincingly remain in business and thus survive. This comprehensive and resource hungry undertaking is no longer the exclusive domains of individual departments and requires a wide focus supported by top executives. Their involvement is essential to succeed in the challenging field of GRC as this new context must be treated as an integral part of organizations' business and IT strategy. The spectrum of its concerns is considerably broad whereby it should coherently be viewed and approached rather than in an isolated fashion. Given the apparent power of JIT supply chain demanding cross-functional integration, the use of this logistical concept for achieving GRC goals in the current dynamic and bumpy economy can surely support the realization of an interlinked framework. Its central aim is to contribute to governing the real-time information factory, treating the associated risks and satisfying any applicable commercial, organizational and regulatory compliance obligations. Consequently, this prominent and forthwith solution is better equipped to also meet the specific GRC needs of modern organizations that utilize the amenities of real-time primary and secondary processes to be a step forward and gain competitive advantage. With this essential business concept rapidly coming into prominence nowadays, most of them vigorously plan to fortify their image, express their identification and boost their presence on the market with the aim of acquiring additional distinction and demonstrable benefit.

REFERENCES

Ackerman, K., Warehousing profitably: A manager's guide, Columbus, Ohio, K.B. Ackerman Co, 1994.

Ballou, R.H., Business logistics management, Eaglewood Cliffs, NJ, Prentice-Hall, 1992.

Bodenstab, C.J., Information breakthrough: How to turn mountains od confusion data into gems of useful information, Grants Pass, Oregon, The Oasis Press, 1997.

Bowersox, D.J., and D.J. Closs, Logistical management: The integrated supply chain process, Singapore, McGraw-Hill, 1996.

Burt, D.N., D.W. Dobler and S.L. Starling, World class supply management: The key to supply chain management, Seventh edition, McGraw-Hill, 2003.

Carlson, B., Supply chain compliance: Jump on board or get run over, Cornerstone Solutions, Inc., August 1, 2005.

Chaudhary, R., GRC is worth it, BizTech2.com, India, September 30, 2007.

Christopher, M., Logistics and supply chain management: Strategies for reducing costs and improving services, London, Pitman Publishing, 1992.

Clair, G. St., The real-time enterprise, Information Outlook, Vol. 6, No. 9, September 2002.

Committee of Sponsoring Organizations of the Treadway Commission (COSO), Enterprise risk management – Integrated framework: Executive summary, COSO, 2004.

Crouchman, C., Getting to real-time requires IT shift, In-Depth, April 2005.

Devlin, B, Data warehouse: From architecture to implementation, Addison Wesley Longman, Inc., 1997.

European Commission (EC), Environment: Commission proposes revised laws on recycling and use of hazardous substances in electrical and electronic equipment, Press Release, Brussels, 3 December 2008.

Francis, J., Keeping SCOR in your supply chain: Benchmarking, Supply Chain Council, 2008.

Hackney, D., Understanding and implementing successful data marts, Addison-Wesley Developers Press, 1997.

Hammergren, T., Data warehousing: Building the corporate knowledgebase, International Thomson Computer Press, 1996.

Harmon, R.L., Reinventing the warehouse: World class distribution logistics, The Free Press, 1993.

Hope, W., Global capitalism and the critique of real time, Time & Society, Vol. 15, No. 2-3, 2006.

Inmon, W.H., C. Imhof, and R. Sousa, Corporate information factory, John Wiley & Sons, Inc., 1998.

Inmon, W.H., R.H. Terdeman, and C. Imhoff, Exploration warehousing: Turning business information into business oportunities, John Wiley & Sons, Inc., 2000.

Inmon, W.H., J.A. Zachman, and J.G. Geiger, Data stores, data warehousing, and the Zachman framework: Managing enterprise knowledge, McGraw-Hill, 1997.

IT Governance Institute (ITGI), COBIT 4.1: Framework, control objectives, management guidelines, maturity models, ITGI, 2007.

Jilovec, N., EDI, UCCnet & RFID: Synchronizing the supply chain, Penton Technology Media, 2004.

Kelly, J., Companies choosing real-time data integration over batch-oriented techniques, SearchDataManagement.com, 07 February 2008.

Korolishin, J., Pick a perfect pack, Stores: SaraMax DC uses light-directed solution to improve accuracy, merchandise flow, Stores, December 2006.

Larson, C., A just-In-Time supply chain?: Achieving Just-In-Time operational objectives requires the coordination of production planning, sourcing and logistics, Whitepaper, UPS Supply Chain Solutions, 2005.

Lind, M., Determination of business process types founded in transformation and coordination, Systems, Signs & Actions, Vol. 2, No. 1, 2006.

Madison, N., What is real-time?, wisegeek.com, 2009.

Manley, N., The benefits of operational business intelligence, Information Builders, 2005.

Othersen, M., J. Penn, K. Kark, M. Rasmussen, and A. Herald, Building a sustainable IT compliance program, Forrester Research, October 2, 2007.

Pataro, C., K. Rajan, H. Huettner, and M. Zervos, Follow the leaders: Scoring high on the supply chain maturity model – The Indian experience, IBM Institute for Business Value, 2006.

Poe, V., Building a data warehouse for decision support, Upper Saddle River, NJ, Prentice Hall PTR, 1996.

Power, D., What is operational business intelligence?, Power Enterprises, 2009.
Sawyer, L.B., M.A. Dittenhofer, and J.H. Scheiner, Sawyer's internal auditing: The practice of modern internal auditing, The Institute of Internal Auditors, 5th edition, 2005.

Tanate, G., ICT onontbeerlijk in moderne voorraadketen, Computable, 42e jaargang, nummer 13, 27 maart 2009.

Tompkins, J.A., and D. Harmelink, The distribution management handbook, McGraw-Hill, Inc., 1994.

Vaassen, E., Research opportunities in internal control, IFAC-PAIBC Meeting Amsterdam, March 28th, 2007.

Womack, J.P., Lean thinking for business processes, Business Process Summit, Boston, MA, June 9, 2005.

Zijlman, W., De materiaalstroom in een gegevensverwerkend proces, Finance & Control, Februari 2007.