Chapter 5
A Quality Assurance System in a Pervasive Computing Environment

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ABSTRACT

As the competition for products and services continues to grow, with customer satisfaction playing an integral part in this process, organizations are faced with the task of ensuring quality in all of their activities. Since many organizations do not necessarily produce the entire product or deliver the service by themselves, they are dependent on other vital sources, for example, suppliers, that impact quality of the finished product/service. This necessitates development and implementation of a quality management system which can integrate information from the various entities to facilitate decision making in a timely manner. Additionally, it is desirable for such a quality management system to be responsive to the existing quality environment at the various sources that contribute to the manufacture of the product or delivery of the service. This chapter provides a foundation for accomplishing such quality management objectives.

PERVASIVE COMPUTING IN THE 21ST CENTURY

The advent of the twenty first century has experienced a phenomenal growth in the need for processing of data/information on a real-time basis. The notion of "anytime anywhere" goal associated with mobile computing is now replaced by "all the time and everywhere" associated with pervasive computing. Advances in several areas have enabled the realization of such. One is the area of distributed computing, whereby seamless access to remote information resources has been accomplished. Further, such communication is possible with the features of minimum fault tolerance, high level of security, and a high rate of availability (Satyanarayanan (2001)).

Networking ubiquity of the World Wide Web has made it feasible to promote pervasive computing. Access to information is dynamic and has been accomplished through the integration of cellular

DOI: 10.4018/978-1-60566-996-0.ch006

technology with the Web (Saha, Mukherjee, and Bandyopadhyay (2002)). However, there are certain desirable features that are necessary to expand the role of pervasive computing. These include the ability to integrate various devices (traditional input/output devices, speakers, light-emitting diodes, wireless mobile devices, etc.), along with smart devices, that include intelligent appliances and sensors, that automatically collect information, transfer it, and are able to take appropriate actions accordingly. Further, effective pervasive computing will require a "middleware" to interface between the networking structure and the end-user applications (Saha and Mukherjee (2003)). Perhaps, the most utility of pervasive computing will be realized through the use of intelligent devices. Such may encompass enhanced wearable devices, identity transponders, and the like of imbedded devices, which has the potential of major breakthroughs in health care (Tentori, M., & Favela, J. (2008)).

Gone are the days where a product or service is manufactured or delivered by a single entity or organization. There are several reasons for this occurrence. First, the complexity of products has increased tremendously. Second, customer needs are varied and dynamic. Third, competition is on a global basis, necessitating the need for continuous improvement. All of these challenges require integration of information from various sources. Such information must be acquired in a timely manner through pervasive computing means. Further, a static model in quality management does not address the continued quality changes that may take place in the various entities. To overcome this problem, an adaptive model is proposed in this chapter.

Traditional concepts of quality management as advocated by renowned experts (Deming (1982), Crosby (1979, 1989), Juran (1986), Juran and Gryna (1993)) are based on the foundation of a single entity having the major impact on the quality of the product or service. The prescriptions on sound quality management principles from these experts are usually therefore guidelines for management of the particular organization.

Customer needs continue to expand and change with time. Since all organizations are interested in increasing their market share, this can be achieved by meeting customer needs, effectively and efficiently, on a dynamic basis. Product specialization has mandated many conceptual changes in the way processes are designed. For example, to address product customization based on customer requirements, the concept of just-in-time production (JIT) has been adopted by organizations (Womack and Jones (1996)). This has the features of reducing inventory carrying costs and lead time. However, it is also based on certain assumptions that must be held to meet demand, quality, and delivery requirements. For example, it assumes that a quality part or sub-assembly will be available, in the quantity that is required based on customer demand. It also assumes that such quantities will be available when they are demanded so as to not increase the lead time for delivery of the finished product as promised to the customer by the organization. A typical example of such a situation is the assemble to order of computers to satisfy specific needs of the customer.

Complexity and specialization of products has had an impact on the procurement and manufacturing functions. Specific components or sub-assemblies associated with a product could be made by organizations (suppliers) distinct from the original equipment manufacturer (OEM). These suppliers have a niche in the production of the component/sub-assembly, leading to improved quality and a competitive price. Because of such efficiencies, the OEM finds it desirable to sub-contract certain components/sub-assemblies to various providers or suppliers. While it allows the OEM to focus on its core competencies, at the same time, it is able to maintain its edge in quality and cost. An integrated quality management model, as described in this chapter, should therefore address the quality of the components/sub-assemblies as it will impact the quality of