

## **A Study on Crowd and Queue Management in Temples During Large Scale Religious Gatherings**

**Renju. R .K**

MBA, Department of Management Studies  
Bharath Institute of Science and Technology,  
Selaiyur, Chennai, Tamil Nadu 600 073  
Bharath Institute of Higher Education and Research

### **ABSTRACT:**

In this paper, we discuss the various challenges that face large scale one-time events that happen especially in religious places like temples. The focus of this article is to understand how Crowd Management in religious places differs from other type gatherings and discuss the role of Information Technology systems to handle the issues that come with such a setting. Specifically, we discuss the issues that arise due to overcrowding of places and how these issues can be resolved using Technological interventions coupled with better system design practices. The discussions in this paper will act as a best-practice reference for crowd and queue management in the times of Information Systems.

### **INTRODUCTION**

In the recent past, religious gatherings have attracted larger crowds than before. For example, Kumbh-Mela in Allahabad had 40 million people gathered in a 20 Sq Km area (Taylor, 2013). Similarly, religious places like Tirupati and Shirdi have seen a tremendous rise in crowds in the last 20 years. This increase can be attributed to the raising awareness about these places, along with reducing costs of transportation and affordability across countries. Moreover, the religious institutions create awareness and cater to the interests of the crowd (Hans India, 2017). Especially, the crowd management becomes more important during one-time large scale events that happen at these places. For example, the Brahmotsavams that happen in Tirupati attract triple the crowd compared to an average day. Similarly, the Guru Poornima Day celebrations in Shirdi attract massive crowds. In this context, it is important to create effective and efficient crowd management systems that can help the visitors in staying safe, while reducing their wait times in long queues.

Another aspect of life that has seen tremendous increase in the past few years has been the technological advancement due to computers. Similarly, the use of mobile phones in India has also reached 70% market penetration. Hence, as a religious institution planning for large scale events, it is important to make use of mediums like these to enhance the safety as well as the experience of the visiting devotees. With this in mind, we explore the role that technology can play in crowd management, in this paper. These queue management issues have been a topic of research in other fields like Hospital queues, carnival queues, restaurant queues etc. Hence it becomes even more important to identify and incorporate the technology interventions that are relevant to this space. Longer Queues give the opportunity to engage people in different ways and technology may also make the wait be utilized in an engaging way.

## **LITERATURE:**

Before we go further, we briefly present the literature that has been previously done on this topic. Court right et al (2002) study the effect of wrong discourses and the ethical crisis that further effects the crowds. Illiyas (2013) discuss in detail the human stampede problem that occurs in large crowd gatherings and offer effective solutions to avert such situations. Their Risk analysis can be used as a framework in approaching such large scale gatherings. Pradeepkumar et al (2011) have also looked into the epidemiology of stampedes at the religious congregation at Sabarimala, in the south Indian state of Kerala, where in a span of a few weeks, devotees from all over India numbering more than the total population of the state congregate. One hundred and nine deaths occurred in the stampede at the close of the festival season here in 2011. Few scientific studies have looked into the sociological and religious aspects of this pilgrimage. Soomaroo (2012) discuss the need of medical support during such mass gatherings, without which, they record the large amount of damage. Main learning points have been identified and further categorized in to 5 key areas: a) Overcrowding and Crowd Control b) Event Access Points c) Fire Safety Measures d) Medical Preparedness and e) Emergency Response. Hence, our study also contributes to this literature by incorporating further insights about technology interventions under such scenarios.

## **MASS GATHERINGS AND QUEUES:**

Traditionally, Queues are defined as line of people awaiting services or products. In terms of economics, we can define a queue as a case of demand exceeding the supply. In the context of religious temples, the demand side is the pilgrims and the supply side the time they get at the main shrine. As demand increases, the queue becomes longer and therefore the time spent at the main shrine ends up getting shorter. Hence, an effective queue and crowd management is essential to a) increase the quality of experience for the crowd and b) provide safety from hazard that can be caused during such gatherings. Different organizations manage queues in different ways. Typically when the wait time is shorter, the queues are not frowned upon by the waiting population. However, once there is a higher level of wait time, it leads to newer kind of problems. Especially for Queues with high variability in wait times, the crowds have a tendency to turn impatient and it hinders their experience that they have set out to. Hence it is important to understand the context before implementing any of the suggested technology interventions. With this background, we next discuss a brief summary of the types of issues that come with crowds.

Crowds vary in multiple dimensions. A significant amount of crowds in religious gathering are senior citizens. A large amount of children are also brought to these gatherings by their parents. We can clearly notice that the kind of services that are required for such varied population will need to be exhaustive. Especially, the older population needs higher amount of medical support along with lesser propensity of stampedes. Hence the medical facilities should be readily available and also accessible. There have been multiple reports where the ambulance couldn't reach a patient due to the crowd. Special maps and route designs need to be made to tackle such scenarios. Similarly, physically challenged and differently abled people will need special services. The gathering should be able to accommodate such cases with the same ease. Therefore, crowds not only bring higher amount of business to local vendors around, but also pose higher risk of adverse events. This provides us with a base argument that crowd management is important for such religious large-

scale gatherings. Therefore, we present a few technology interventions that can be extremely useful in such scenarios.

## **TECHNOLOGY INTERVENTIONS IN MASS GATHERINGS:**

As described in the previous section, the main contribution of this paper is the discussion on technology interventions into queue and crowd management. Here, we present four important areas where such technology interventions can be used. They are discussed below:

### **A. ONLINE QUEUE MANAGEMENT**

The first technology intervention is online queue management system. The idea of an online queue management system is that the visitors can register to be a part of the queue by signing in to their online account. This can be done either using their mobile phones on an app, or using a website that will be provided to the users. Hence, by registering in an online queue, the users do not have to be physically present. This will save a lot of crowd flocking on the outdoors during these gatherings. These users will be given a time to report when they check-in through the queue management system. At that given time, they have to report at a prescribed location, to avail the service in a much lesser time. This way the users avoid long wait lines and also enable the use of technology.

However, this method has its own disadvantages too. If the users delay their reporting time, then it disrupts the services for the next set of people. This will cascade into the wait times for all the following people. Therefore, it becomes more important for the registered participants to have real time updates on the status. In the next section we discuss the nature of real time updates that can help these online queue management systems work more efficiently.

### **B. REAL TIME UPDATES**

The real time updates are an essential complementary service for the online queue management systems. The users who enroll in the online queue management system need real time updates to ensure that they do not report on the wrong time. Moreover, the real time updates will also help the users to make more informed decisions on the services they would want to avail. For example, if there are three services in the gathering with varied wait-times, then the user can avail the real time information to make a decision on the order of services that they want to enroll. Real time updates also have other advantages. Using real time updates can also avert extreme scenarios and stampedes. The information regulators can use this platform to divert information and nudge the users to make socially optimal decisions by distributing the crowd across places. Hence, real time updates need to be considered, irrespective of the higher fixed costs that are associated with them.

### **C. RESOURCE ESTIMATION AND PLANNING**

The idea of resource estimation and planning can be seen as the biggest technology intervention. Using statistical methods and machine learning, the users can predict a large scale future events given a previous set of observational data. For example, the time series analysis of crowds can estimate the number of people that are expected to visit on a particular gathering. This will help in making plans accordingly for an upcoming scenario. For example, if the data on number of wheel chair requests is available from the past events, the algorithms can estimate the number of such

requests that might happen in the upcoming time periods. This can be seen as method that can aide better design of practices available to the event organizers. Such implications are described in the following section.

#### **D. REDESIGN PHYSICAL SPACES WITH TEMPORARY REQUIREMENTS**

The implications of physical space redesigns need to be discussed in conjunction with resource estimation and planning. The issue of temporary requirements is cost effective mechanisms to avoid additional expenses during such gatherings. The temporary requirements can be made after the demand is estimated properly and the services are made available more easily to the crowd. This includes the medical facilities, the food and hygiene planning, and the safety planning. The above technology interventions have been implemented successfully by Tirumala Tirupati Devasthanam (TTD), the organization that manages Sri Venkateswara Swami temple in Tirupati. They have been received with great success. They have also incorporated a lot of ERP tools as well.

#### **CONCLUSIONS:**

In this article we introduce and discuss various technology interventions that can be used to aide effective crowd and queue management in large-scale religious gatherings. Such gatherings differ from other type of large scale gatherings like concerts, in the sense that the visitors wait for their turn to avail services, like visiting a shrine. Therefore we discuss the technology interventions like online queue management systems with real time updates. We contribute to the literature on crowd management. Although the best practices are similar to other contexts like hospital, retail, restaurant queues, the context of religious gatherings have a different kind of motivation among the visitors, that will make them more receptacle to information. Hence, a medium of information that can help them get real time updates is also suggested. Along with these best practices, we open doors for further research on issues that range from demand estimation using statistical methods as well as physical redesigns implications. In the age of technology, religious organizations need to invest more into such services to deliver high quality support and service to their visitors, especially during mass gatherings.

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