ESSAYS

A reliability study of commentary systems used at football matches

by Tawanda Victor Mutshiya and Kristian Adendorff

The success or failure of operations involved in broadcast commentaries can be attributed to the reliability of constituent broadcast commentary subsystems and components. Reliability, simply put, is a facet of quality assurance that considers a collection of components that are arranged in a structure that allows the system state to be determined as a function of its component states.

Reliability is essentially a probability, and in the context of broadcast commentaries, can be defined as follows: The probability that the commentary system will adequately perform its specified purpose of enabling video and sound output for the specified duration of a football match under prevaling environmental conditions.

Environmental conditions are assumed to be constant since the commentary system is often used in environments at room temperature that employ air conditioning systems to ensure a constant temperature and humidity.

The commentary control room is the main operations centre for commentary services, where all commentary facilities are handled in a complex arrangement. Ideally, broadcasters demand 100% reliability of consistent live broadcasts, which are ensured through built-in redundancies by way of satellite feeds and backup equipment, but still, no one system is 100% reliable.

During the FIFA 2010 Soccer World Cup, a complex commentary system was used, and even with the built-in redundancies, minor problems, such as lip-sync and excessive variable loudness errors, were noted, which influenced the overall reliability of the system.

John Moulding, on the official blog of the International Broadcasting Convention (IBC) of 2010, states: “There is still work to be done to ensure ‘the five-nines’ reliability needed to achieve consistency.” He refers to a failure rate of one in 100 000 runs of broadcast equipment, and infers that a reliability of approximately 0.99999 is sufficient to achieve consistency in broadcast system operations.

The reliability model for the commentary system configuration used at football matches can be modelled as the series reliability of the subsystems shown in Figure 1.

The stadium system involves the location from which audio and video signals originate. The signals are propagated through a variety of subsystems in the stadium system, which include commentary positions, the commentary control room, the technical operations centre (the main distribution point and interface between facilities used to transfer signals) and the commentary interface room.

From the stadiums, the signals are sent via fibre optic cables, which are made redundant by satellite feeds, to the International Broadcast Centre (IBC) system. In the IBC, signals are propagated through the master control room, which acts as the central distribution point at the IBC for all incoming and outgoing video and audio feeds from the stadium venues, and the commentary switching centre, which controls and patches all the commentary circuits coming from stadiums to the IBC and beyond.

In the IBC, the feed is combined and sent to various television broadcast

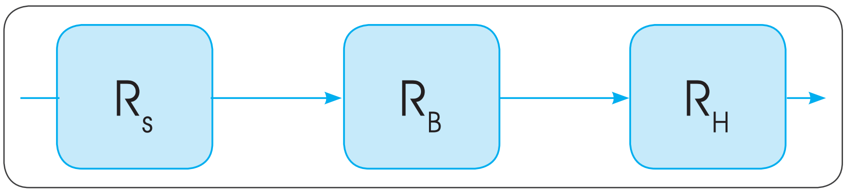

Figure 1. Constituent subsystems of the commentary system.

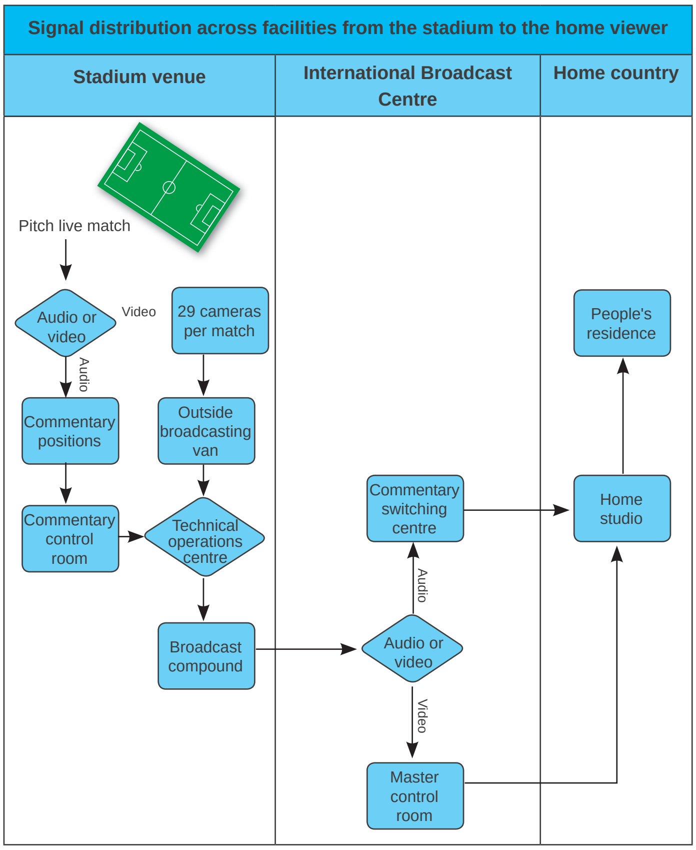

Figure 2. Reliability block diagram.

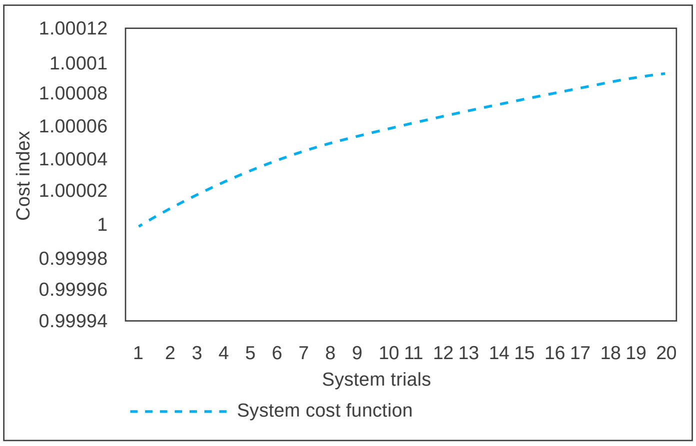

Figure 3. System cost function obtained from the commentary system reliability values.

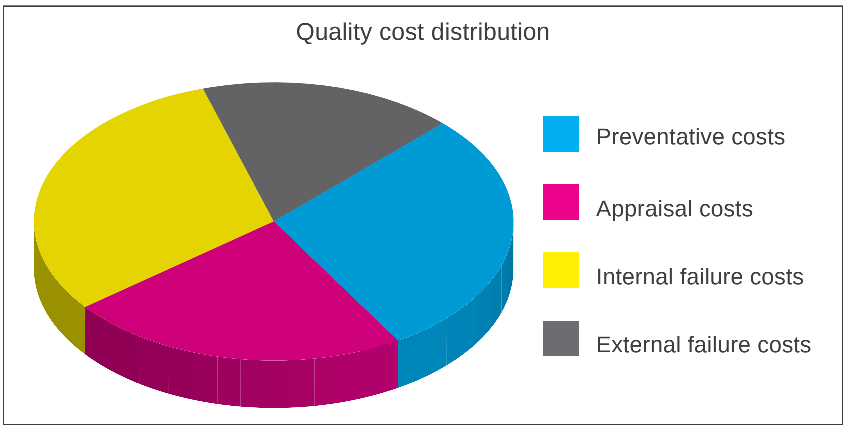

Figure 4. Quality cost distribution.

studios around the world. The reliability of these is denoted by R_H in Figure 1. Signal distribution across facilities is shown in the reliability block diagram in Figure 2.

Commentary system reliability is significantly influenced by the impact of human reliability, since man-machine interfaces are ubiquitous throughout the entire system. It is important to note that man-machine interactions in the commentary system are tightly coupled with some that are composed of complex interactions. Consequently, this has led to the viewpoint that technicians and commentary components are seen as interacting parts of the overall system, and are thus not considered separately as components. In addition, technicians and various users of the commentary system rarely work alone and form part of a team. In a reliability context, this means that the technicians' actions are a result of beliefs and cognition, rather than simple responses to events influenced by environmental factors, and that these beliefs may be shaped and shared to various degrees by the group.

Reliability varies naturally across environments to which the commentary system is exposed, including penalties. This reduces the ability of broadcast investors to forecast cash flows. A reliability cost function is therefore used to gauge cost as a function of the system reliability. An exponential behaviour of the cost is assumed and the function has the following form:

$$C = e^{(1-f)*(R(i) - Rmin)/(Rmax)}$$

Where:
C is the cost index as a function of the system reliability
f is the probability of improving the reliability
Rmin is the minimum achievable reliability that may be allowed
Rmax is the maximum achievable reliability of the system

From the reliability data obtained, the system cost function is shown in Figure 3. The system cost function draws towards a constant maximum, reflecting all the efforts involved in maximising the reliability of the system. This is due to the maximum attainable probability value of reliability

A commentary control room identical to the ones used during the FIFA 2010 Soccer World Cup.

being 1, and therefore all efforts to ensure that reliability is as great as possible will always reach a maximum when the highest desired reliability is reached. These efforts to ensure a high reliability value form part of what is referred to as the Cost of Quality Model. This model breaks costs down into four groups: prevention costs, appraisal costs, internal failure costs and external failure costs.

Prevention and appraisal costs occur as a result of having backup equipment, redundancies and using improved technology to prevent defects in propagating the audio and video signal feeds to viewers.

Internal and external failure costs come about as a result or consequence of the fact that no single system built is 100% reliable, despite the best efforts to prevent service defaults.

A summary of the costs obtained from the quality cost report, detailing the financial consequences to attain improved reliability, is shown in Figure 4.

The pie chart in Figure 4 illustrates a distribution of the cost facets of the quality model. Prevention and appraisal costs make up 52% of the total, indicating that the broadcaster spends more on mitigating failures and detecting defects in the system through appraisal and prevention activities. An increase in the appraisal activity of a broadcaster will lead to more defects being identified before live broadcasts, resulting in higher internal costs by way of the cost of scrap, reworking and downtime of the defective equipment observed. This positively influences external costs, which become less as savings are made in warranty repairs, warranty replacements, as well as costs incurred in field servicing. The pie chart indicates that external failure costs are the lowest, owing to the influence of appraisal activities.

Further emphasis on prevention and appraisal may have the effect of reducing total quality cost as prevention and appraisal costs should be more than offset by a decrease in internal and external failure costs.

Sources

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