

Chapter 19

Robot Reliability Design and Improvement Method Using Advanced TPS

ABSTRACT

The automobile industry uses many robots, and a practical scientific approach of reliability enhancing activities is the key to the realisation of a highly reliable production system of faster operating production robots. The reliability of the robots is improved not only by hardware designed to be more reliable on the supplier side, but also by collecting and analysing the user's observations at the production line over a long period of time. The author has established the Robot Reliability Design and Improvement Method (RRD-IM) by developing Advanced TPS. This method has been implemented worldwide in an advanced car manufacturer and has produced a better operating life cycle for industrial robots.

INTRODUCTION

To survive amidst severe competition, Japanese enterprises have recently been promoting global production, to achieve uniform quality worldwide, and increased production at optimal locations. This trend and a particular production environment have led the author to establish “Advanced TPS” (Advanced Total Production System) as the strategic development of “New Japan Model” named “New JIT” for manufacturing in the 21st century (Amasaka, 2002, 2007a, 2009, 2014, 2018; Amasaka and Sakai, 2010). This section concentrates on the strategic application of Advanced TPS and the creation of a highly reliable production system based upon it (Amasaka and Sakai, 2009).

Nowadays, the automobile industry uses many robots, and a practical scientific approach of “reliability enhancing activities” is the key to the realisation of a highly reliable production system faster operating production robots. The reliability of the robots is improved not only by hardware designed to be more reliable on the supplier side (Craig, 1988), but also by collecting and analysing the user's observations at the production line over a long period of time (Kitano, 1996; Atkeson and McIntyre, 1985; Atkeson *et al.*, 1986). The author has established a strategic manufacturing technology for the robots named

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“Robot Reliability Design and Improvement Method” (RRD-IM) (Sakai and Amasaka, 2007a) (Refer to Chapter 7). RRD-IM contains three core methods of evaluating robot reliability: initial failure (-IF), random failure (-RF) and wear failure (-WF). The author has implemented RRD-IM at an advanced car manufacturer A and achieved the anticipated results. Then, based on these three failure modes, they have implemented the reliability design to ensure better line availability.

The author has also suggested a methodology to increase reliability through defining the target value of MTBF (mean time between failure), in preparation for a global production strategy. They have simultaneously achieved a QCD (quality, cost, delivery) programme enabling manufacturers to offer high product assurance (Sakai and Amasaka, 2007a,b, 2013, 2014; Amasaka and Sakai, 2009; Amasaka, 2015, 2017, 2022).

DEVELOPMENT OF ADVANCED TPS

In recent years, the technical manufacturing capability in the Japanese manufacturing industry has declined as the result of production transfers to overseas locations. Yet high quality assurance at PPM (parts per million) level is needed in the domestic plants, and the following requirements have emerged: (1) Worldwide quality assurance (2) Uniform productivity all over the world

The Key to Success in Global Production using Advanced TPS

The author addressed the requirements above and organically integrated four core technologies to develop Advanced TPS as an effective manufacturing technology for global production, Figure 1(2), Chapter 6 (Sakai and Amasaka, 2005, 2013, 2014; Amasaka, 2006, 2007a,b) (Refer to Chapter 6 and 15).

The mission of Advanced TPS is to achieve epoch-making improvements in productivity, cost, quality, and workability. The four core elements are: (a) Integrated Quality Control System, (b) Highly Reliable Production System, (c) Rational Advertisement Promotion System and (d) Intelligent Operator Development System.

In the near future, the reformation of production workshops by the production facilities administration, ideal maintenance, and the advancement of traditional Toyota Production System for high quality assurance and a highly reliable production system, will be required (Amasaka, 2015, 2017, 2022) (Refer to Chapter 3).

The Necessity of a Scientific Approach

The necessary requirements for a highly reliable production system are, 1) Fast repair of facilities in the event of a breakdown (maintainability), and 2) Speed of production (productivity) (Kelly, 1997). Regarding maintainability, the primary objective of maintenance is to provide quality products promptly (Wang and Marvin, 2000). For this, it is essential to improve the administration of the production facilities to enhance availability (Smith, 1993; Modarres et al., 1999).

The author therefore structured and developed ARIM-BL (Availability Reliability Information Monitor - Body Line) at an advanced car manufacturer A, with excellent results. ARIM-BL consists of two systems, (a) a body measurement system and (b) a line information administration system, which allows data to be accessed in real time from the facility (Amasaka and Sakai, 1996, 1998).

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