Zero Variation Manufacturing (ZVM) - A strategy for robust products with zero perceivable variation - DTU Orbit (10/08/2019)

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Every customer expects the purchased product to deliver the performance exactly as promised by its manufacturer. Robustness is a product characteristic that relates to performance consistency. Product performance deviates from its design intent due to internal variations generated in the manufacturing. The manufacturer considers internal variations to control only when the performance falls below the specified limits, or the product fails before the warranty limit. This situation is indirectly generating a loss of satisfaction among customers. When manufacturer eliminates all variations or their effects on a product’s performance, all the product units perform identical, as intended and achieve higher user satisfaction. This research project aimed to discover the methods and approach required for a product manufacturing company for making robust products shows zero variation in the performance. This means that any product unit made from a factory on any day will give precisely the same performance to the users according to the use conditions. The research focussed on building a manufacturing strategy suitable for any product or process to achieve product robustness. Initially, the study ensured that there was no ambiguity in the definition of product robustness and clarified the research scope, objectives and several research questions. A detailed literature review and study of current industry practices helped to identify the gap and set the study approach for finding answers to the pre-set questions. A generic stage-gate process of New Product Development (NPD) was taken as a basis, and each stage was conducted to fill the gap. A process of "estimating the final product performance at every stage and adjust to bring it back to target, if deviated" is the aim. Current Automotive, Medical Devices, Equipment manufacturing industry practices were studied to derive a generalised process. Product robustness has two components, namely Unit-to-Unit and Within-unit robustness; these were proven to be feasible for estimation within the factory before the parts are even assembled. A strategy coined, Zero Variation Manufacturing (ZVM) was derived for achieving product performance consistency. ZVM provides an opportunity to estimate product performance and correct it at each stage of manufacturing; Conceptualization, product maturation and production; was illustrated through case studies. All the stages are verified for the feasibility of quantifying robustness and achieving zero variation. The Impact of the new strategy's implementation on the current industry product development process was discussed, and the required changes were identified. ZVM has been validated for industry acceptance through interviews with experts and practitioners; who found the acceptance (logical & feasible) of ZVM to be 93%; the current knowledge and infrastructure for implementation were 75%. This research sought of change the current industry view that "variation is intrinsic" and aimed for zero variation by proving ZVM's feasibility at each stage of manufacturing.