



# Searching For The Ideal Machine: How Strategy Drives VEX IQ Robot Design (MRI Inspiration & Outreach Series) (Volume 4)

*Rohit Anant Narayanan, Christopher Hyun-gu Kang, Angela Mingjia Wei, Gabriel James Wimmer, Michael Lawrence Djourup, Aanya Advani Hudda*

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Searching For The Ideal Machine: How Strategy Drives VEX IQ Robot Design is a handbook that explores the relationship between strategy and engineering design in the field of competitive robotics. The book provides a methodology for finding success in competitive robotics. The process starts by determining the key functional requirements of a season's game, and details and discusses a variety of machines and mechanisms that can satisfy such requirements, using the 2015 VEX IQ Highrise game as an illustrative example. These machines and mechanisms can be versatile (or general purpose) or specialized (or of limited purpose but with higher performance). The problem of building stable irregular stacks is discussed and solved in a mathematically rigorous way. Next the authors develop a taxonomy of robots, classifying the various common types of machines into a set of six robot "families" - pushbots, clawbots, harvesters, plowbots, gantries and (task-optimized) cherrypickers. The authors show how compliance of designs with game rules on robot sizing can be evaluated prior to construction using simple trigonometry. The book applies these principles to the 2015 VEX IQ Highrise game, developing a variety of strategies for transport, sorting and stacking of game objects. Next the authors show how these specialized strategies can be combined for improved competition performance using an evaluation schema that considers the maximum and likely score and the reliability of the machine to assess the suitability of each machine for solo and alliance teleoperated as well as autonomous robotics based upon its strengths in transport, sorting and stacking of game objects. After describing their favored solution to the exemplary problem, the authors provide a detailed methodology for extending such an approach to future competitions. Written in plain English for a middle school audience (both students and coaches), most of the book is accessible to elementary schoolers as well. Two sections of the book are mathematically sophisticated— particularly the sections on designing robots for rules compliance, and the mathematically rigorous solution to the problem of building stable irregular stacks. Elementary and middle robotics coaches may find this book useful to illustrate robotics concepts and help train their students in designing the optimal machine for their chosen strategy. The machines, mechanisms and assessment process described in this book will prove useful to future season robotics competitions.

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