The Technologist's Role in Forming the Start-up Strategy

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Robert "Mike" Gardner

Vice President of Engineering and Operations
MicroPower Global Incorporated

Given the complex technical, product development and intellectual property issues faced by technology-based ventures, the lead engineer or scientist is a critical team member for the formation of a strong start-up strategy. Often the founding technologist *is* the CEO and may have neither prior experience in the role nor significant work experience.

In our brief 40 minutes we will attempt to bring a guiding perspective to the technologist's role in forming the start-up strategy. We will identify the key strategic and tactical contributions the technologist *must* spearhead lest the business folks take license to grope naively in the unknown. We will show examples of the means to form the key strategies and address the scope of these activities so our minds can rest a bit easier as we attempt to anticipate the unknown.

We will use examples from the start-up venture, MicroPower, as well as proven tools from Fortune 100 companies in developing strategic focus and tactical plans through:

- Identifying and specifying "green field" applications for your technology
  - Application, supply chain, eco-system, and maturation road-maps
- Identifying and estimating markets and key target metrics
  - TAM, penetration, target price and cost
- Developing a patent portfolio perspective and an appropriate war strategy
  - Competition, assessing quality, quantifying cost
- Execution! Execution! Execution!
  - Strategic focus, tactical plan, managing risk

Robert “Mike” Gardner

Vice President of Engineering and Operations
MicroPower Global Incorporated

Mike Gardner is a seasoned technology executive and start-up professional with over 23 years experience in both large corporations and small start-ups. He currently serves MicroPower Global as the manager and project lead for the technology development and day-to-day operations. He is an original co-founder of MicroPower having developed both the technology and business plan for the company. Prior to MicroPower, Mike served Motorola for 18 years in various management positions rising to Managing Director of R&D and Fellow of Technical Staff for Motorola where he led project teams on three continents developing cutting-edge technologies. Additionally Mike founded and served as President of Financial Strategies, a Financial Services start-up, and Valley Regent, a Non Profit organization as well as architecting a successful start-up spin out in Semiconductor Services. He started his career as a Mechanical Engineer at Texas Instruments.

Mike has built a three-prong career reputation: he builds high-performing technology teams; he masters new technologies quickly; and he is an experienced program leader who delivers high-impact solutions on time and in budget.

Mike has an Entrepreneur Program Certification from the University of Chicago (2003); Master of Business Administration from Regent University (1994); Master of Science in Electrical Engineering from Arizona State University (1985); and a Bachelor of Science in Mechanical Engineering from Northern Arizona University (1979). He is the author of 15 patents, 30 publications, and is a frequent speaker with 26 significant public engagements.

Model of Heat Exchangers for Waste Heat Recovery from Diesel Engine Exhaust for Thermoelectric Power Generation

Chad Baker

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Abstract

The performance and operating characteristics of a hypothetical thermoelectric generator system designed to extract waste heat from the exhaust of a medium-duty turbocharged diesel engine was modeled. The finite difference model consisted of two integrated sub-models: a heat exchanger model and a thermoelectric device model. The heat exchanger model specified a rectangular cross-section geometry with liquid coolant on the cold-side, and accounted for the difference between the heat transfer rate from the exhaust and that to the coolant. With the spatial variation of the thermoelectric properties accounted for, the thermoelectric device model calculated the hot-side and cold-side heat flux for the temperature boundary conditions given for the thermoelectric elements, iterating until temperature and heat flux boundary conditions satisfied the convection conditions for both exhaust and coolant and heat transfer in the thermoelectric device. A downhill simplex method was used to optimize the parameters that affected the electrical power output, including the thermoelectric leg height, thermoelectric n-type to p-type leg area ratio, thermoelectric leg area to void area ratio, load electrical resistance, exhaust duct height, coolant duct height, fin spacing in the exhaust duct, location in the engine exhaust system, and number of flow paths within the constrained package volume. The calculation results showed that the configuration with 32 straight fins was optimal across the 30 cm wide duct for the case of a single duct with a total height of 5.5 cm. In addition, three counter-flow parallel ducts or flow paths was found to be an optimum number for the given size constraint of a 5.5 cm total height and parallel ducts with counter-flow was a better configuration than serpentine flow. Based on the reported thermoelectric properties of $MnSi_{1.75}$ and $Mg_2Si_{0.5}Sn_{0.5}$, the maximum net electrical power achieved for the three parallel flow paths in a counter-flow arrangement was 1.06 kW for a package volume of 16.5 L and exhaust flow enthalpy flux of 122 kW.

Bio

Chad was born and raised in Dallas, TX, and his most notable achievement during his youth was earning the rank of Eagle Scout. Chad continued his education in the mechanical engineering undergraduate program at Texas A&M University, driven by a passionate curiosity to understand the thermodynamic workings of the internal combustion engine. Having gained that knowledge too early in the program, Chad became interested in graduate school to enable the pursuit of deeper, more technical learning challenges. Chad went to the University of Texas in pursuit of a doctorate in mechanical engineering with a focus in thermal fluids systems. As a master's student, Chad worked on novel substrate materials for automotive catalytic converters, and his most substantial contribution to the field was developing a model that correctly predicted catalytic hydrocarbon conversion efficiency as a function of numerous variables associated with material properties and macroscale geometry. For Chad's doctorate work, he joined a team working on thermoelectric (TE) waste heat recovery from automotive exhaust. Chad's focus on this project was modeling the TE device thermal and electrical performance, modeling the convection in the heat exchanger system, coupling the TE and heat exchanger models, and experimentally verifying system performance metrics. Chad plans to work in a national lab after completing his Ph.D. work, and he is hopeful that he can use his skills to contribute to the betterment of humanity and to help the United States maintain technological competitiveness.