Southside High School – Robotics Team
2005 Call for Entries

Description of the Nominated Organization: Southside is one of 14 high schools in the School District of Greenville County. It has an International Baccalaureate curriculum. The SHS Southside Automated Machines (SAM) InvenTeam was formed to invent an innovative prototype of a remote controlled stair climbing device for carrying firefighting equipment up stairs that would address the primary cause of on-the-job related firefighter fatalities, namely stress and fatigue.

1.) Provide supporting information describing your innovative technology product, service, program or process to be recognized, including relevant dates and locations of development/implementation.

Description of innovative program: In September of 2004, Southside High School created the Southside Automated Machines (SAM) InvenTeam enabling Southside to be selected as one of only 13 schools nationally for a Lemelson-MIT InvenTeam grant. The team received $9,100 to invent a remotely operated stair climbing device for firefighters that could carry firefighting gear up stairs. After selecting the idea, the team had 8 months for the research, design, and fabrication stages culminating in a working prototype to be unveiled at an MIT conference in June 2005. Note: the project was not a game or competition but the creation of a real world device. There were no rules, instructions, or specifications indicating how the device should be designed nor was any kit full of parts provided by Lemelson-MIT. All design decisions, parts ordering, and engineering had to be done from scratch. The grant selection process occurred in two steps. The first part consisted of submitting a detailed application in May of 2004 which demonstrated that the applicants had an idea as well as the backing, knowledge, and tenacity to pursue it. This part was used to select finalists. As a finalist, the team had to refine the invention idea, contact potential users, evaluate the usefulness of the device, do a patent search, research possible solutions, formulate a detailed cost estimate for producing a prototype, and put together an organization of students, teachers, and mentors in only a month's time in order to be considered for the grant. After receiving the grant the team was expected to submit monthly progress reports, generate press releases, and closely monitor spending as well as develop the invention's prototype. Spending was a big issue since the grant's budget was set at a time when few design details were fully known. Fortunately, many local and national businesses donated materials and supplies in support of the project. This community support made it possible to complete the project under budget, in spite of its many uncertainties. Very few team members had even drilled a hole at the start of the project let alone designed anything using CAD. Tools available in the team's work shop were limited to hand tools and woodworking tools like a drill press, band saw, and table saw. Team members had to be trained in fabrication skills as well as CAD. Often ingenuity had to be used to compensate for a lack of equipment. For example: the team refined a process for laminating thin aluminum sheet metal to plywood in order to compensate for a lack of fabrication equipment. The laminates were almost as strong as solid aluminum for far less cost and weight. The laminates could also be machined with woodworking tools. When parts could not be fabricated with the team's tools, various community organizations, businesses, and individuals generously stepped in to help get the parts machined. The team's official roster listed 25 students, although many not listed participated in various aspects of the project. Members met once a week after school for planning meetings and on Saturdays for work sessions. As often as possible, the project was extended into the classroom. Design calculations were performed in physics classes and background research was done in statistics class. Computer science classes designed, built, and programmed the device's powerful battery operated computer for controlling its movement and operating its video camera eye. Computer science classes also built a smaller highly customized robot based on the commercially available ER-1 robot for use in testing wireless communication and software capabilities. The overall project generated numerous real world examples of how classroom knowledge can be applied. The team was extremely diverse and was roughly equally divided between males and females. It included Asian, Hispanic, and African-American students as well as a number of students from a diversity of countries, such as Cambodia, China, India, The Philippines, Spain, Sweden, and Vietnam not to mention South Carolina natives. Student participants ranged in age from a Southside bound middle school student to high school seniors. Mentors who donated hundreds of hours of their time from start to finish included a teacher, an engineer, and two networking administrators. Other consultants and specialized mentors were too numerous to list but included a firefighter and a retired Detroit fire chief. The final full sized, radio-controlled prototype now called Fire SAM weighs about 200 pounds, contains a twelve volt computerized control system, four 24 volt motors, two sets of stair climbing tri-wheels, and a video camera all in a compact package able to make turns on small sized stair landings, as well as climb stairs. Fire SAM has been greeted with enthusiasm by the team's firefighter/consultant. During the team's final presentation at MIT, Fire SAM—with robot music playing and its warning strobes flashing— roared across the stage and climbed the stairs into the crowd, amid cheers and applause. Fire SAM will be formally introduced to Southside High students next year as well as make appearances in middle schools and at Roper

Mountain Science Center. He will also be further refined. Currently he is geared for a top speed of 5 mph which has proven to be a bit fast for safe, reliable stair climbing. His control system also needs refining. The SAM InvenTeam will continue working on him next year as well as looking for new devices to invent and new ways to involve students in projects where they can put classroom skills to work solving real world problems. The SAM InvenTeam's web site is located at http://www.greenville.k12.sc.us/southside/RoboticsInvTm.htm . While the team is based at Southside it is open to other interested and qualified high school students who wish to participate.

2.) Briefly describe the primary objectives of and value derived from this technology product, service, program or process. Value can be defined as having strategic, customer, financial, operational and/or social impact. Be sure to document the results and contributions of the product, service, program or process, including what and how audiences/beneficiaries were impacted.

Primary objective and value derived from the program: The team's real-world invention goal was as follows: Invent and build a prototype of a remote controlled stair climbing device for carrying firefighting equipment up stairs. The device was to address the primary cause of on-the-job related firefighter fatalities, namely stress and fatigue (surprisingly not burns or smoke inhalation). The primary educational objects were threefold: 1) Provide students with hands-on experience in the invention process from generating an idea through building a working prototype, in a process similar to running a small business involving fundraising, budgeting, and public relations work as well as engineering and fabrication. 2) Give students real world examples of how classroom knowledge can be applied. 3) Excite students in the school and community about math, science, engineering, and innovation.