Jayant S. Sabnis

Vice President, Engineering – Module Centers
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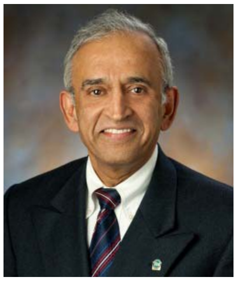

Dr. Jayant Sabnis earned his B. Tech. from IIT Bombay in 1975 and Ph.D. from Syracuse University in 1981. He started his career in Propulsion Systems Gas Dynamics in the 80's, where he made significant contributions in the development and application of computational analyses for multi-phase reacting flows in solid and liquid rocket motors. The analytical capability developed during these research programs was used in the failure analyses and design improvements in the Space Shuttle Main Engine, the Solid Rocket Motor as well as a few other solid rockets.

In 1992, Dr. Sabnis joined United Technologies Research Center, where he actively led several R&D programs in propulsion systems and turbomachinery. In 1998, Dr. Sabnis transferred to Pratt & Whitney and assumed responsibility for the Secondary Flow & Heat Transfer discipline and the internal air system integration gas turbine engines. In 1999, he was appointed Director, Mechanical Systems. In this position, Dr. Sabnis led the group in developing analytical approaches to design and analysis of Mechanical Systems and implementation of novel design concepts to manage fluid flows in lubrication systems. In 2002, Dr. Sabnis was appointed Director, Aerodynamics, where he was responsible for all aspects of aerodynamic designs of P&W engines, as well as defining technology programs related to the Aerodynamics Discipline.

In 2004, Dr. Sabnis assumed responsibility as Chief Engineer, Systems Analysis and Aerodynamics. In this capacity, he was responsible for all aspects of engine performance, operability, control and diagnostics system, as well as component aerodynamics and acoustics. He was one of the three Chief Systems Engineers at Pratt & Whitney Engineering, who constitute the System Level Design Review Board for reviews through all phases of Integrated Product Development for all of Pratt & Whitney engines. Dr. Sabnis was directly responsible for functional design of all P&W Engines. He led a group of over 800 engineers in Systems Engineering to define engine cycles, component level aerodynamic design for all primary gas path components, the operability requirements as well as the development of engine control and diagnostics system meeting these requirements.

Dr. Sabnis played the lead role in defining the thermodynamic cycle for the Pratt & Whitney Geared Turbofan Engine™ family as well as securing air-framer/airline acceptance of this step change in engine architecture. He has also provided the leadership to the team responsible for the aerodynamic design of these engines, which provide over 15% improvement in fuel consumption for the aircraft engines while simultaneously reducing the noise. The step change in fuel consumption and the noise reduction provided by these engines has enabled the launch of the Mitsubishi Heavy Industries MJET, the Bombardier C-Series, and the Airbus A320neo aircrafts. This engine has also been selected as the sole power plant for the next generation E-Jet series regional jets by EMBRAER, Thus, the engine now powers six different next generation commercial aircrafts.

Dr. Sabnis assumed his current role as Vice President, Engineering – Module Centers at Pratt & Whitney in March 2013. In this role, he is responsible for the Module Center Engineering function that executes the design, development and field support of all the Pratt & Whitney Engines components.

Dr. Sabnis holds six patents and has authored over 20 technical publications. He is a member of the advisory board for the AIAA Journal of Propulsion and Power. He is a Fellow of the AIAA and the ASME. Indian Institute of Technology, Bombay has recognized Dr. Sabnis' accomplishments with the Distinguished Alumni Award – the highest level of recognition awarded by the Institute to its alumni.

ABSTRACT

Functional Design of a Quiet, Fuel-Efficient Aircraft Engine

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A recent issue of *Time Magazine* (November 28, 2011) listed the 50 Best Inventions of 2011 and identified the PW1000G Geared Turbofan Engine, developed by Pratt & Whitney, as "the most important development in aviation in 2011". A distinguishing feature of this engine that earned this honor is a step-change reduction in the fuel consumption as well as the noise produced by the engine. The change in the mechanical architecture of this engine, compared with the conventional civil engine architecture, is easy to notice. However, the change in functional design philosophy is not as easily visible.

Aero-thermodynamic definition of an aircraft engine in the early phase has profound impact on the engine functional characteristics. Choices made at this stage define, among other things, the fuel burn and the noise, considerations that the emphasis on environmental impact has brought to the fore. Choice of mechanical architecture puts further limits on fuel burn and noise. More specifically, turbofan engines in which the fan is directly coupled to the low pressure turbine are near the limits of the design space, so the direct-drive turbo fan (DDTF) engine forces the designer to trade fuel burn for lower noise or vice-versa. The gear-drive turbofan (GDTF) architecture, however, allows the designer to change the paradigm resulting in lower noise and reduced fuel burn simultaneously. In this, it is important to note that these benefits are *not provided directly* by the fan drive gear system (FDGS), but rather *enabled* by it.

The lecture provides a first-principles based description of the functional design dilemma and its resolution. The features of the engine architecture are shown both from the technical perspective, and from the perspective of the in-depth (and protracted) interactions between engine manufacturer and airframer that were needed to create the opportunity for the GDTF to emerge as a key aspect of the single-aisle civil transport market.