

# First Flight of Gripen E Will Reveal True Cost of Fighter Development

*Defense-aerospace*

*Giovanni de Briganti*



***The first of three Gripen E test aircraft was unveiled with much ceremony exactly a year ago, and after a six-month delay it could finally make its maiden flight within the next month. (Saab photo)***

PARIS and LINKOPING, Sweden - The next-generation variant of Sweden's Gripen fighter is due to make its maiden flight sometime during the next month, between the first anniversary of its official roll-out on May 18 and the June 19 opening of the Paris Air Show.

Whenever it happens, this flight will mark the appearance of a fighter that Saab defines as fifth-generation, but that it says was developed for less than 2 billion euros – just about half the \$4 billion cost of the Lockheed Martin F-35's Block 4 software.

Whether or not that figure remains valid – and it probably won't, given the way the program has evolved – the difference in development costs is huge, even taking into account Lockheed's exorbitant pricing policy on the entire F-35 program, whose R&D phase has doubled in price to over \$50 billion.

## **Small Is Beautiful?**

The story of the Gripen E is not so much the story of an aircraft as the story of how a comparatively small, family-managed company set out to "break the cost curve" and how it

succeeded in doing in less than one decade what the world's biggest defense contractor has failed to do in two.

And that story is compelling – although perhaps not as much as Saab will have you believe – because it explains how a country of fewer than 10 million people has managed to develop several generations of combat aircraft on its own, while much bigger and richer European powers like Germany, the United Kingdom and Italy have given up and instead opted for international cooperation.

In fact, it is remarkable that today France and Sweden are the only European countries still capable of developing an entire combat aircraft; that in both cases their know-how rests with relatively small but diversified family companies, and that these companies share the ingrained belief that their survival depends on efficiency, and on their ability to meet customer requirements at an affordable cost.

This translates into a counter-intuitive management approach where bureaucracy is kept at a minimum, and where accountability is accompanied by much more devolved decision-making than is normal in high-tech engineering companies.

The similarities end there, however, because Gripen E is a lightweight, single-engined fighter derived from an existing aircraft, and therefore required substantially less development than other fighters. It is comparable, in many regards although not in cost, to the latest variants of the Lockheed F-16, such as the F-16V Viper being marketed to India.

### **First flight 18 months overdue**

This does not mean there have been no difficulties. Originally, Gripen E's first flight was originally planned for the second half of 2015, was rescheduled to late 2016 and is now officially due for the second quarter of 2017 – which is already halfway over.

According to Saab spokesman Sebastian Carlsson, the first delay is due to the fact that, after Switzerland pulled out of the program, Sweden decided to return to the original schedule, which called for first deliveries in 2019.

The second delay was decided by Saab in what company executives said in London was a deliberate decision to complete full qualification of the software, avionics and sensors interface before the first flight.

### **Breaking the Cost Curve**

Faced with the prospect of developing an upgraded version of the Gripen for the Swedish Air Force, Saab decided early on that it would have to either completely revolutionize its processes and design approach to keep costs affordable, or leave the combat aircraft market altogether.

Gripen E's development was made possible by two strategic decisions taken at the program's beginning: finding new, less costly ways to develop competitive products, which

Saab calls "breaking the cost curve," and finding new ways of integrating leading-edge subsystems and components from foreign suppliers into a new, Swedish-designed aircraft.

The approach it chose was to go entirely digital, while at the same time rethinking its approach to development and production. The resulting processes read like an alphabet soup, but have allowed Saab to develop the Gripen E in less than 10 years at a cost of less than \$2 billion - including three test aircraft.

For comparison purposes, the only other Western combat aircraft now in development, the Lockheed Martin F-35, has been under development for 16 years, and its development, originally due to cost \$23 billion including its engine, has now more than doubled.

The two aircraft, however, are broadly comparable in software complexity, as Saab says the Gripen E has over 10 million lines of code, while the F-35 reportedly has 23 million, which may or may not include Block 4 software. Both companies are actually obfuscating the issue: during briefings in Sweden last year, the figure of 20 million lines of code was provided, although officially the company only says "over 10 million."

Saab also says that it has fewer than 3,000 people working on the Gripen E program; by comparison, the F-35 Joint Program Office employs nearly as many -- 2,590 military personnel, government civilians and full-time equivalent contractors -- just to run the program.

Such large variations in the cost and time needed to develop the only two Western combat aircraft in the 21st Century should raise major questions about whether these discrepancies are warranted by anything other than corporate greed.

## **New management approach**

Saab clearly broke new ground in development methodology even if it avoided the expense of developing the costliest subsystems by buying the engine (General Electric F414), the ES-05 Raven AESA radar and Infra-Red Scan and Track (from Leonardo-Finmeccanica) and several other subsystems off-the-shelf from first-rank suppliers.

"As regards Gripen E, Saab is under contract with Sweden and Brazil and the aircraft will be delivered with the Leonardo AESA Raven radar," Saab spokesman Conal Walker said June 6. "The Saab AESA fighter radar has been offered to India for the Tejas LCA programme, and could also be used for retrofit and mid-life upgrade programmes on other platforms."

The challenge, then, was to find a way to integrate these existing components and subsystems into the Gripen E seamlessly and avoiding the huge integration costs that normally run into the hundreds of millions of US dollars for each one.

According to Jerker Ahlqvist, Head of the Gripen program, the solution was to adopt new ways of working, including model-based systems engineering (MBSE), model-based development (MBD), and agility, that is to say that the company's simplified management structure was adapted to react quickly and adapt to change.

Talking to company officials, two other factors also played a major role. One is the company's devolution of responsibility, which allows engineers to take many decisions without

having to refer to upper management or to committees. This empowerment, says company executive Carl-Henrik Arvidsson, results in few mistakes but greatly accelerates the development process.

The second factor, which in different guises is on the lips of every executive, is the sense that the company has a duty not only to develop the combat systems needed by the Swedish military, but to develop them at a price the country can afford. Even though Saab's shares are publicly traded, its board is dominated by the Wallenberg family, which holds 41% of the votes, and which appears to believe that profit should come from export, and not from domestic sales.

Arvidsson, for example, notes that Saab returned to the Swedish government almost \$500 million in unspent development funds for Gripen C/D generation, an uncommon gesture for a commercial company.

## **Software and Apps**

The concept that guided the development of the Gripen E's software architecture was the brainchild of an unnamed Saab engineer who, much impressed by the Apple iPhone's structure, decided to try whether a similar approach could be applied to a modern combat aircraft.

Pursuing this idea meant completely overhauling the traditional way of developing complex software, but Saab went ahead anyway and decided to break down the Gripen E's software architecture into two categories: anything that was flight-critical – but only what was really flight-critical - went into the basic software, while anything to do with tactical aspects – weapons, sensors, tactics, data fusion – was put into a series of specialized programs that interface with, but are independent of, the basic software.

This means that, just like the Apps in an iPhone, specialized programs can be easily and simply added and deleted without interfering with any flight-critical functions.

Interestingly, Israel Aerospace Industries has adopted a similar approach, allowing it to add Israeli-made sensors and weapons to its Lockheed Martin F-35Is without having access to the software source codes.

"Using generic communications infrastructure based on the latest Software Defined Radios (SDR)," the new C4 system developed for the F-35I Adir "enables rapid software and hardware development cycles that will also provide more affordable modernization and support of systems" in future, IAI said in an April 3 press release. A company official later added that, under the F-35 agreement, IAI had developed a specific ICD interface for the Israeli C4I systems.

But the only way to judge the effectiveness of Saab's innovative approach to aircraft development will be when Gripen E flies, and begins flight testing.