OBJECT LESSONS
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Object Lessons from 1628

Experience has shown that someone’s proven ability to do an excellent job on a given scale is by no means a guarantee that, when faced with a much larger job, he will not make a mess of it.

E. W. Dijkstra
“Notes on Structured Programming”
*Structured Programming*
In 1625, the Swedish Navy was victorious in the Baltic waters. It was so successful that King Gustav commissioned the construction of a new flagship for his fleet — to be the grandest flagship in all of Europe.

To build this ship, the *Vasa*, he selected Hendrick Hybertszoon, a master shipwright from Holland. After a brief meeting to discuss the “requirements” for this ship, the master shipwright returned to his small workshop and built a scale model of the proposed flagship. The king was delighted by the model and appropriated a small oak forest to provide the timbers for his new ship.

There were no written specifications. Lumber was cut under the assumption that the ship would be approximately 108 feet in length. At the first review meeting, the king requested that the ship be made larger by 135 feet. The master shipwright complied by patching the keel, adding a new length of timber, and extending the ship to 120 feet. As leveling of the forest began, the king departed for a summer vacation in the south of Sweden.

While on vacation, the king discovered that the Danish king also had recently commissioned the construction of a flagship, but the Danish ship was to have three gun decks — one more than the Swedish vessel. Therefore, upon his return to Stockholm, King Gustav demanded a project review. He was impressed with the ship’s architecture and proposed decorations, and so approved the design with one modification — the addition of a third enclosed gun deck with 50 brass, 24-lb cannons.* He also commanded the shipwrights to complete the ship several months ahead of schedule — no matter the cost.

The shipwright was stunned; How could he request such a major structural

*This would be the weight of the cannonball, not the cannon itself. Each cannon was different, but most weighed 1 ton or more.
change after the keel had been laid and the planking nearly completed? But because the customer was king, the shipwright reluctantly complied.*

Mathematics and physics were not well developed in 1625. It was more than a decade before analytic geometry was discovered by Descartes and five decades before Newton’s first publication of the calculus. So in 1625 a shipwright would guess, model, build, and learn.

It was also the tradition among shipwrights of that era to keep the specifications for successful ships a closely guarded secret. None of the calculations accounted for 50 tons of added weaponry, nor for a heavy multistory brick oven for cooking. The builder surmised that adding a new gun deck would require the addition of some planking along the sides and some additional ballast (130 tons added to the 122 tons already planned). However, there was not enough room for another 130 tons of rock under the existing deck, so it was left out for the time being. Using the best tools available, master builder Hybertszoon calculated the changes required to the planking and communicated those changes to the shipwright. The shipwright, without asking, added about 5 inches to the width of the ship just to be sure.

When the flagship’s modification was complete, a navy admiral conducted a stability test by instructing 30 sailors to run from side to side on the deck. The test was considered “successful enough” even though the ship nearly tipped over the third time the sailors ran from side to side. Approval was given because nobody could figure out how to solve the problem, and the king demanded that the ship be completed on schedule.

After vespers one Sunday in August 1628, the Vasa set sail from Stockholm harbor. Amid glorious celebration, the ship sailed out into the Stockholm archipelago. About one mile from the harbor, a modest gust of wind caught the mainsail and the ship “turned turtle,” sinking immediately.

**OBJECT LESSONS**

The state of software building today bears striking parallels to the state of shipbuilding in the early 1600s:

- Shipbuilding was a craft with an inadequate underlying science and “engineering practice.”
- Specification was accomplished in an *ad hoc* manner — typically verbally.
- Design methods were inadequate — just make a sketch or two, build a model, and extrapolate to the real thing.

*Due in part to the stress, Mr. Hybertszoon became seriously ill and died a year before the Vasa was completed. His brother and business partner, Arent Hybertszoon de Groote, became the new master shipwright despite the fact that he had considerably less experience than his brother.*
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Object Lessons

Figure 1.2. The Vasa's ornate carvings included about 1,000 sculptures. “[The sterncastle] is crowned with an ornamental flower bud decked with acanthus leaves; immediately below appears the decorously draped torso of a turbaned herm, then a large grotesque mask, and below that a king wearing Roman armour and holding a sword in one hand; at his feet is a convoluted shield displaying griffons [sic].” Expensive gold and indigo paints adorned the carvings. Golden lions' heads protected each gun port batch.
Object Lessons from 1628

- The full implications of a change were not understood — the addition of a gun deck could not be accommodated by simply adding more ballast as more weight might cause the waterline to rise above the first gun deck!
- Indications of trouble from empirical testing were often ignored.
- Far too much time and effort were wasted carving lions' heads and other statuary prior to determining if the ship would sail.
- “Success breeds failure.” It is not enough to continue doing what has worked in the past.
- In 1626, shipwrights had not learned how to tell their clients “no,” even if the client was king.

Other lessons emerge from the Vasa tragedy. After 333 years of sitting peacefully on the not very salty bottom of Stockholm harbor, Anzer Franzén discovered the remains of the Vasa and convinced the government to finance its recovery and reconstruction (see Figure 1.3).

After two decades of work and thousands of gallons of polyethylene glycol (a preservative of green or wet wood), the Vasa once again is moored in Stockholm harbor. From this experience, software developers should remember:

1. The systems we build may last far longer than we ever imagine (333 years).
2. Maintenance costs often exceed the original development costs — even for unsuccessful products!
3. Tiny pieces of what we build today may be carefully examined and scrutinized decades or even centuries from now.

During the next major war in which Sweden became engaged nearly 50 years later, King Karl XI commissioned a new flagship for his fleet, the Kronan.\(^2\) The Kronan was built using a design similar to the Vasa, but it was almost twice as long and carried nearly three times the weight of cannon.

The Kronan sailed successfully for nearly four years. But on June 1, 1676 it was engaged by the Danish and Dutch fleet near the Swedish island of Öland. In response to the attack, the Kronan turned too tightly, its third gun deck flooded, and the ship sank, killing some 800 men. Forty-nine years and 10 months after the sinking of the Vasa, the consequences of an initial design error resulted in an even greater loss of life.

Ship design, construction, and maintenance in the 1600s bear a striking resemblance to the experiences many of us have had while building software systems in the 1980s. The goal of this book is to motivate a change process that has the possibility of fundamentally altering the way in which software systems are built. We’ll begin with a look at some successful software products to understand their com-
mon properties. Then, an important new software technology will be described and an explanation of how this technology can be put into commercial practice today with a minimum of risk will be provided. The book concludes with a look ahead at where the software industry is taking us and how soon it will get us there.

NOTES

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Assessing Our Craft

The tyranny of large systems sets up a numbers barrier to future advances if we must rely on individual discrete components for producing larger systems.

J. A. Morton

*International Science and Technology*

July 1966, p. 38.