

Vasa – case study

Some of the material in these slides is adapted from Len Bass et al., Fairley et al.

The Vasa



The Players

- King GustavusII Adolphus
 - the customer
- Admiral Fleming
 - the contracting officer (CO)
- The Hybertsonbrothers
 - Arend: business manager
 - Henrik: shipwright (designer & project manager)
- Hein Jacobbsson
 - Henrik' sassistant
- Johan Isbrandsson
 - the subcontractor (construction)
- Captain Hansson
 - the end user

Some Background circa 1625

- During the 1620s, Sweden, Poland, and Denmark were engaged in an arms race
 - Sailing ships were the WMDs of the era
- In January 1625, Sweden's King Gustavus Adolphus directed Admiral Fleming to sign a contract with Stockholm shipbuilders Henrik and Arend Hybertson to design and oversee construction of 4 ships
 - 2 ships were to have 108 foot keels
 - 2 ships were to have 135 foot keels

Vasa Background

- In September, 1625 the Swedish Navy lost 10 ships in a devastating storm
- In response, the King ordered the 2 smaller ships to be built on an accelerated schedule
- Construction of the Vasa began early in 1626 as a small, traditional ship with 1 enclosed gun deck
 - it was finished 2 ½ years later as a large, innovative ship after undergoing numerous changes in requirements
 - the 108 foot ship ended up as a 135 foot ship
 - with 2 enclosed gun decks

Requirements Changes

- At first, the 108 foot keel was scaled up to 111 feet
- Then the King learned that Denmark was building a large ship with 2 enclosed gun decks
 - The 111 foot keel was then scaled up to 120 feet and later to 135 feet
- Because of schedule pressure, the 111 foot keel was extended to 120 feet and then to 135 feet without rescaling the overall design and doing the necessary re-construction
 - which resulted in a shallow keel with 4 scarf joints

Requirements Changes

- Adding a 2nd enclosed gun deck required widening the upper beam of the ship and increased the weight of the upper ship
- A series of on-going and confusing changes in armament requirements resulted in a plan for 48 24-pounder guns
 - only 36 were installed at launch
- The second gun deck and the large guns raised the center of mass, thereby increasing the instability of the ship

Scaling up

- The specifications were scaled up many times
 - hull length
 - broader beam
 - 2nd gun deck
 - armaments
 - ornate carvings
- No one in Sweden had ever built a 2 gun-deck ship
 - including the shipwright and the ship builder

Team co-ordination or lack off...

- The Vasa was the largest project ever undertaken in Sweden
- More than 300 people worked in 5 uncoordinated teams
 - hull
 - rigging
 - armament
 - decoration
 - ballasting

Shipwright's death

- Henrik Hybertsson became seriously ill in late 1625
 - and died in the spring of 1627
- During this time, “management of the project was weak”
 - responsibilities were shared by Hybertsson and his assistant, Hein Jacobsson
 - with unclear division of responsibilities and poor communication between them

Failed lurch test

- A “lurch” test was conducted in the presence of Captain Hannson and Admiral Fleming
 - 30 men ran from side to side amidship
 - after 3 traversals the ship was rocking so violently it was obvious it would capsize if the test continued
- Admiral Fleming complained to the boatswain (Mattson) that the ship was carrying *too much* ballast

Why was Vasa Launched?

- Pressure from the King to launch the ship as soon as possible
 - the King had ordered that the Vasa be launched on July 25
 - if not “those responsible would be subject to His Majesty’s disgrace”
 - the Vasa was launched on August 10
 - 2 weeks behind schedule
- Inability to communicate with the King
 - he was in Prussia (Poland) fighting a war

Why was the Vasa launched?

- The (new) shipwright and the shipbuilder were not present at the lurch test
 - they testified that they were unaware of the failed lurch test
- No one had any suggestions for making the ship more stable

The Result

- When launched, the ship sailed about 1300 meters and capsized in a light gust of wind
 - it was estimated that the gust was about 9 knots
 - recent calculations indicate that the ship would have capsized at about 4 knots
- 53 lives were lost (30 – 50?)

Vasa Museum



Discussion Questions

- List down the consequences of the changes/ requirements creep
- What were the problem areas?
- Who is to be blamed?

Consequences of Requirements Creep

- Keel was already laid; schedule pressure prevented redesign or re-construction
- Adding the 2nd enclosed gun deck raised the center of mass
 - the upper beam of the ship was widened
 - heavier timbers were used to support the 2nd deck and increased gun-weight
 - outfitting with 24-pounder guns further raised the center of mass
 - massive, ornate carvings on the stern also raised the center of mass

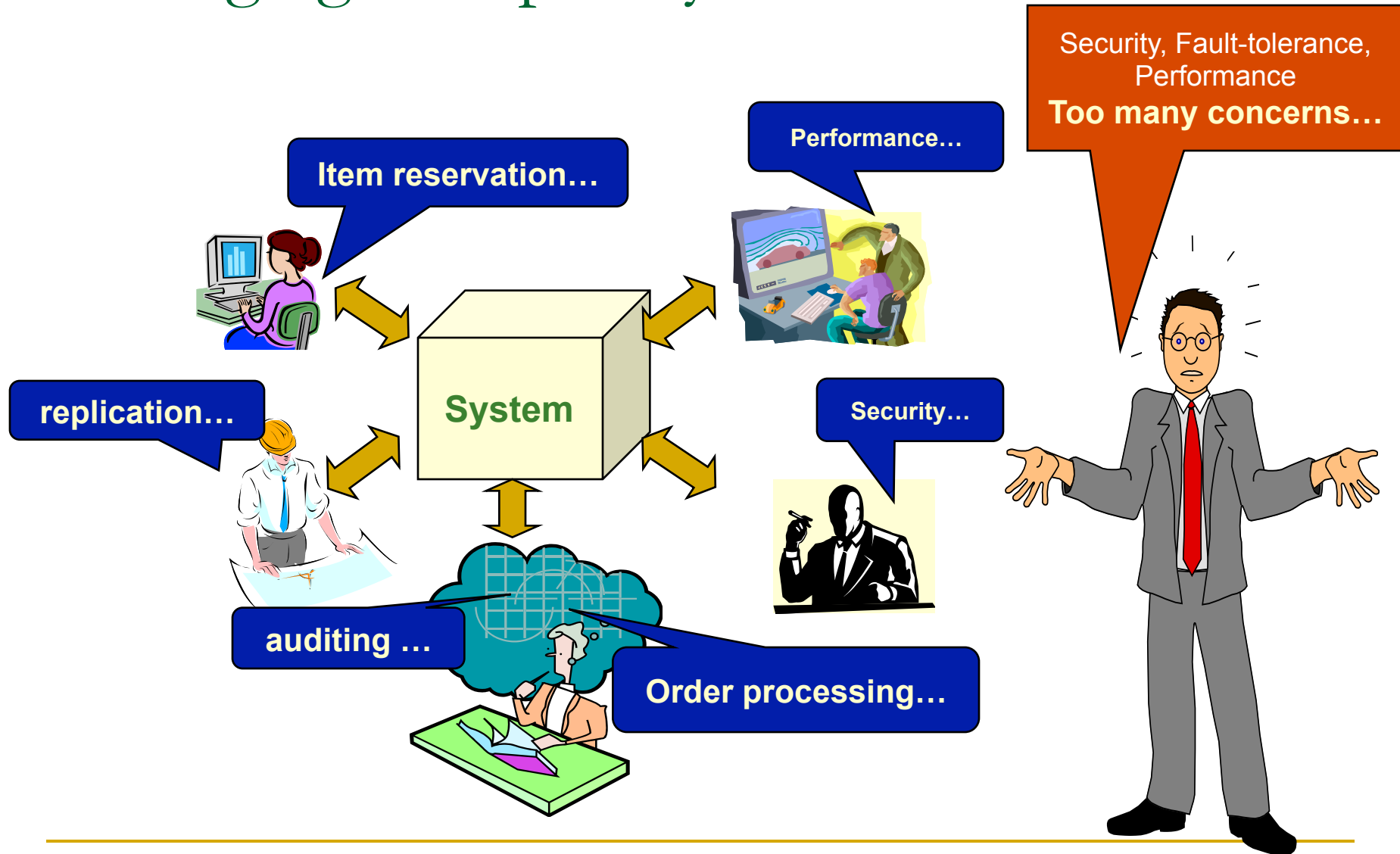
Some problem areas

- No specifications for the keel
- Scaling up the keel and the upper decks
- No design specifications or construction guidelines
- No documented project plan
- Changing armament requirements
- No weight budget or weight control
- No way to calculate stability, stiffness, or sailing characteristics
- Unstable funding for the project
- No coordination among teams
- The shipwright's death
- The failed stability test
- “bigger is better”

Who was to blame?

- The King (the customer) for changing the requirements and exerting schedule pressure
 - and for creating funding problems
- The first shipwright (the chief architect) for dying
- The shipbuilder (the prime contractor) for not replacing the shipwright when he became ill
- Admiral Fleming (the contracting agent) for allowing the launch of an unstable ship
- Captain Hansson (the end user) for agreeing to the launch

Managing Complexity



Key point

- Balancing Constraints
 - Functional concerns
 - Non-functional concerns

Becoming a Software Architect

- **Well versed in software analysis and design techniques, as well as architectural and design patterns**
- **Fluent in several programming languages**
- **Excellent verbal communication and writing skills**
- **Excellent at critical thinking and knowledge acquisition**
- **Ten or more years of experience in software development**