



Maintenance & Reliability

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The Fleet

160 vessels

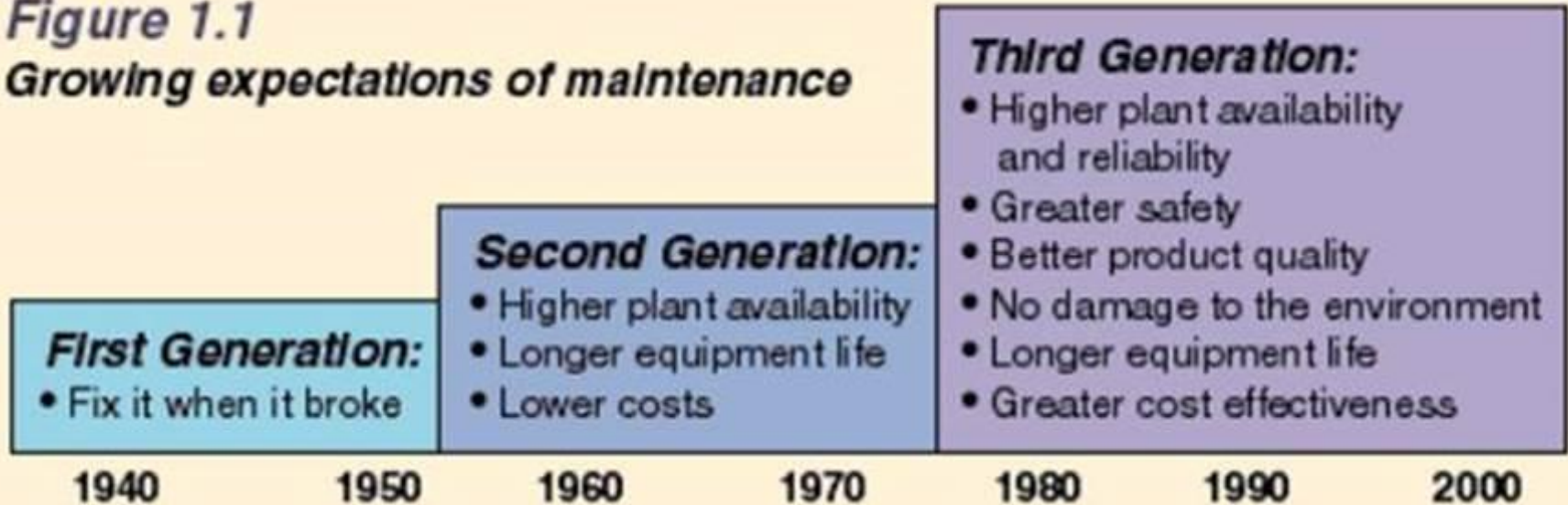
- **480.000 ton steel**
- **320 radar systems**
- **960 engines**
- **480 propellers**
- **8000 pumps**
- **??? km cables**
- **??? km pipelines**





Maintenance Management

Figure 1.1
Growing expectations of maintenance

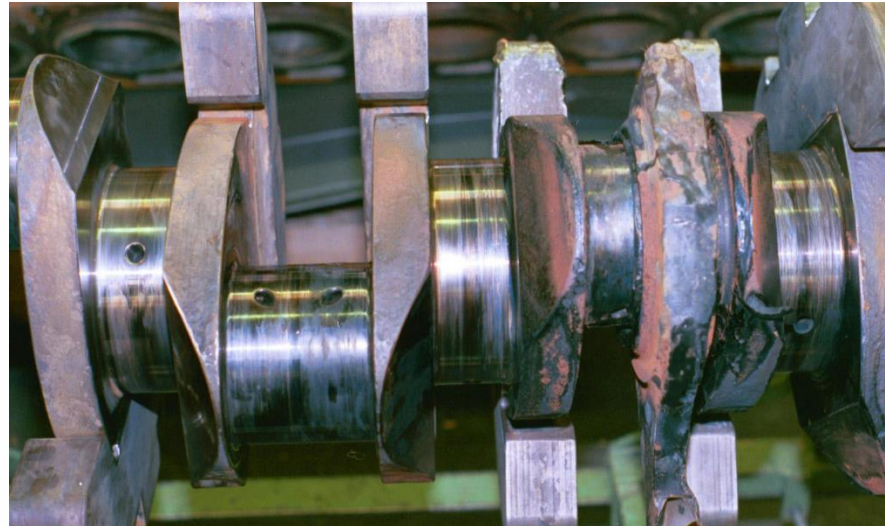




Maintenance Management

- **Experienced engineers**
- **Familiar with their equipment**
- **Planned maintenance system**

- **Result**











Maintenance Management

Probability of failure as function of time.

	<p>Increasing Failure rate. (Age related failure behaviour)</p>
	<p>Constant Failure rate. (Random Failure behaviour)</p>



Failure Rate pattern studies data

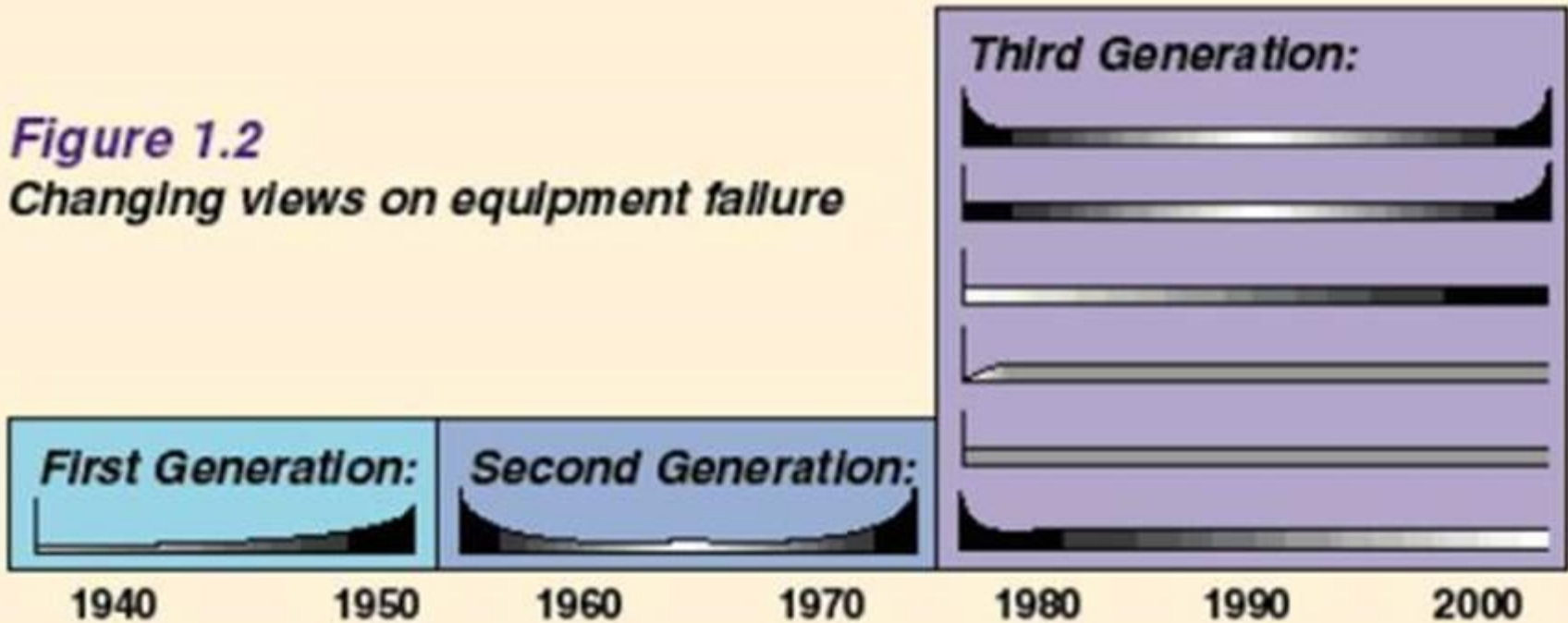
	Airlines		US Navy	
	UAL 1968	Broberg 1973	MSP 1982	SUBMEPP 2001
	4 %	3 %	3 %	2 %
	2 %	1 %	17 %	10 %
	5 %	4 %	3 %	17 %
	11%	8 %	23 %	29 %
	7 %	11 %	6 %	9 %
	14 %	15 %	42 %	56 %
	68 %	66 %	29 %	6 %
	89 %	92 %	77 %	71%

Studies showed that actual failure probability behaviour was more diversified.



Maintenance Management

Figure 1.2
Changing views on equipment failure

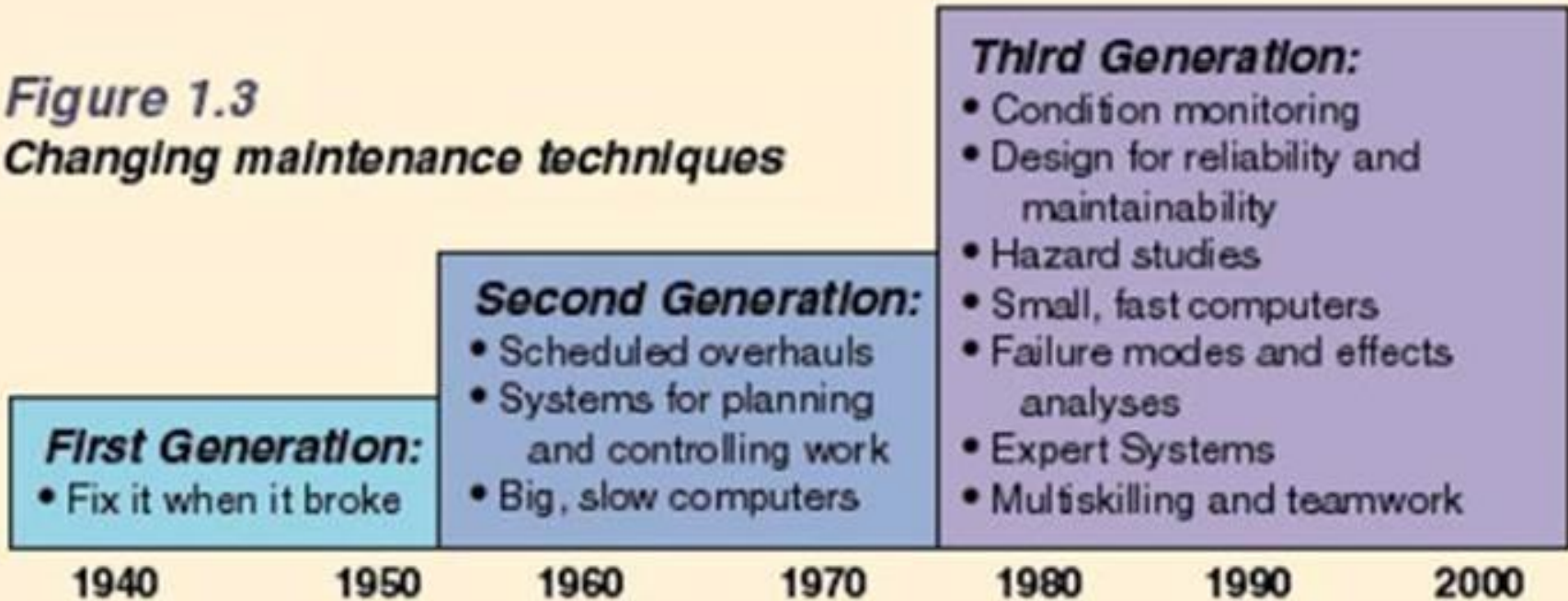


- According Lloyds: third generation maintenance management systems are used on less than 2% of the world fleet .



Maintenance Management

Figure 1.3
Changing maintenance techniques



Reliability Centred Maintenance:



Maintenance Management

RCM

- Check your system
- What is the result of a component failure
- What is the failure rate pattern of each individual part/component.
- Is there redundancy in the system
- Do we require any condition monitoring

Result:





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