Graceful degradation to prolong lifetime of semiconductors

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Conclusion

Sustainability footprints are caused by semiconductor malfunctioning; production challenges (low yield) and customer returns (wear-out). We work with standards, techniques, and methods to quickly and accurately pin-point and mitigate malfunctioning aiming at graceful degradation to prolong operational lifetime.
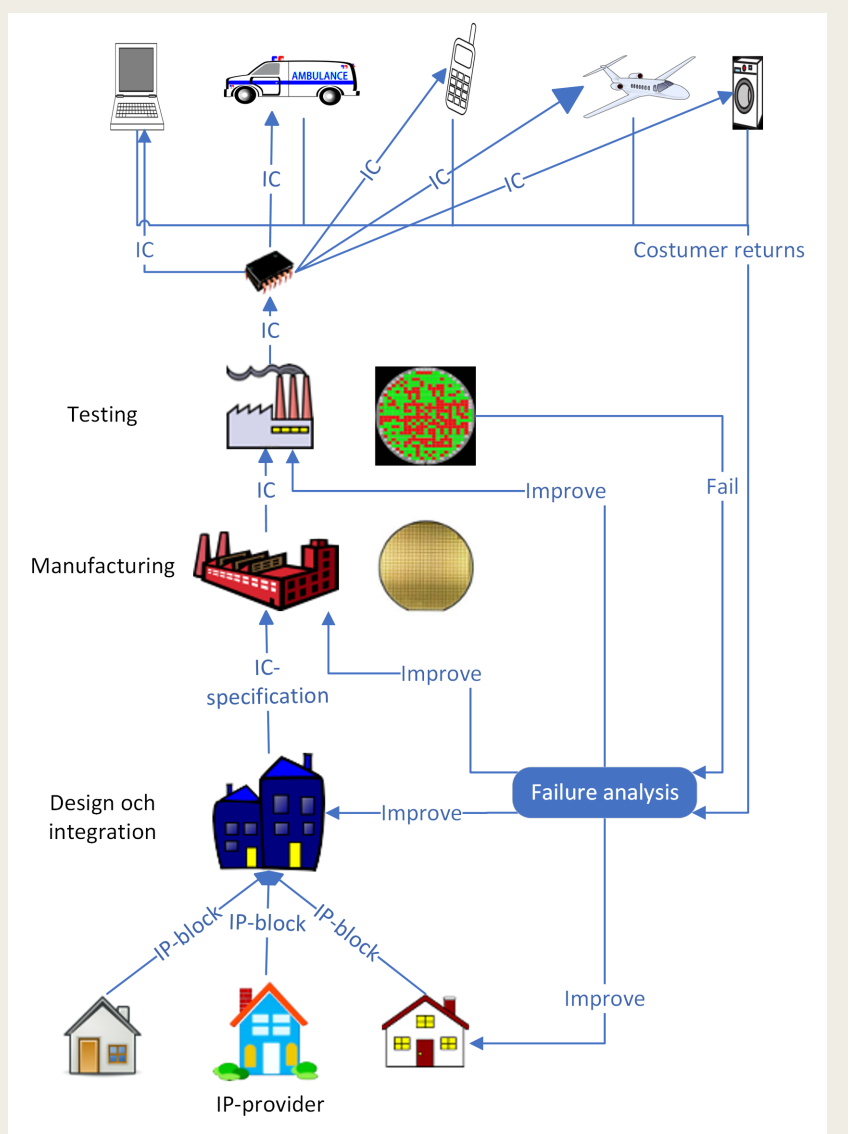
Introduction

As our society goes digital, there are semiconductor components in everything; from advanced medical and telecommunication systems to personal devices like mobile phones, television, and washing machines, and everything in between. The semiconductor industry is one of the largest industries in the world with an annual production value of approximately US$400 billion [1].

More advanced semiconductor components give yield challenges at production and wear-out faults during operation. The problems are:

- Yield challenges at production increase the chemical waste [2]
- Wear-out faults during operation increase costumer returns, which give repair cost (material, transportation) and shorter operational life-time (earlier product replacement) [3]
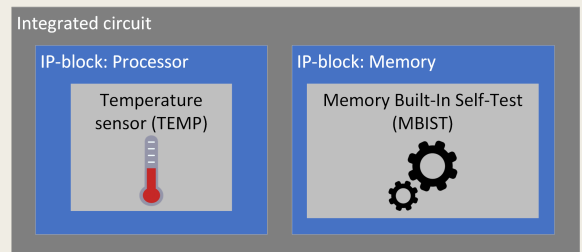
[1] World Semiconductor Trade Statistics. More Than 25 Years Authentic Market Monitoring by Wsts. Available online: https://www.wsts.org/

[2] Shen, Chien-wen and Tran, Phung Phi and Minh Ly, Pham Thi, "Chemical Waste Management in the U.S. Semiconductor Industry", Sustainability, Volume 10, Number 5, Article 1545, 2018

[3] Accenture Report—"A Returning Problem: Reducing the Quantity and Cost of Product Returns in Consumer Electronics," by David Douthit, Michael Flach and Vivek Agarwal, 2011

Background

40 years of development.

Computer	IBM PC	Apple Imac	Difference
Year	1981	2021	40 years
Price	45000 SEK (1981)	15000 SEK (2021)	9 times **cheaper**
Processor	**Intel 8088**	**Apple M1**	**Difference**
Transistors	29 000	16 000 000 000	550000 times **more**
Clock period	210ns (4.77MHz)	0.31ns (3200MHz)	670 times **faster**
Technology	3000nm	5nm	600 times **smaller**

IC · IC · IC · IC · IC · IC · IC · IC

Costumer returns

Testing

Improve · Fail

Manufacturing

IC-specification · Improve

Design och integration · Improve

Failure analysis

IP-block · IP-block · IP-block

Improve

IP-provider

if TEMP<limit then run MBIST

Integrated circuit

IP-block: Processor
Temperature sensor (TEMP)

IP-block: Memory
Memory Built-In Self-Test (MBIST)

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