

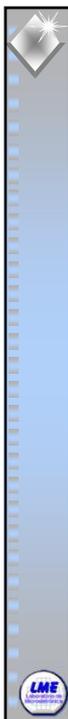


INTRODUÇÃO AOS

PROCESSOS DE FABRICAÇÃO EM MICROELETRNICA



1



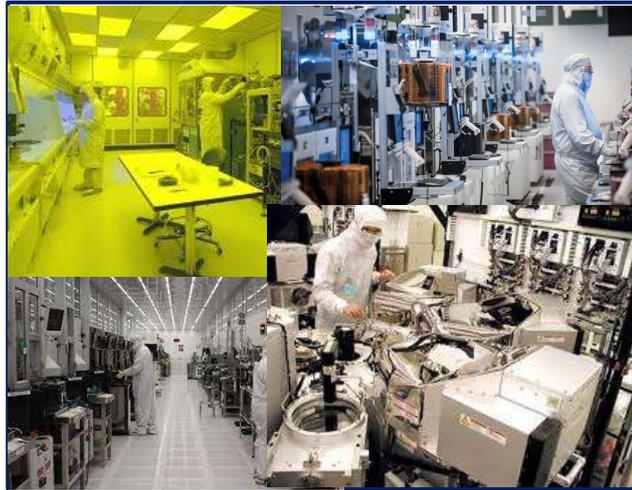
Como e onde é feita a fabricação de Circuitos Integrados?

Fabricação de Circuitos Integrados



2

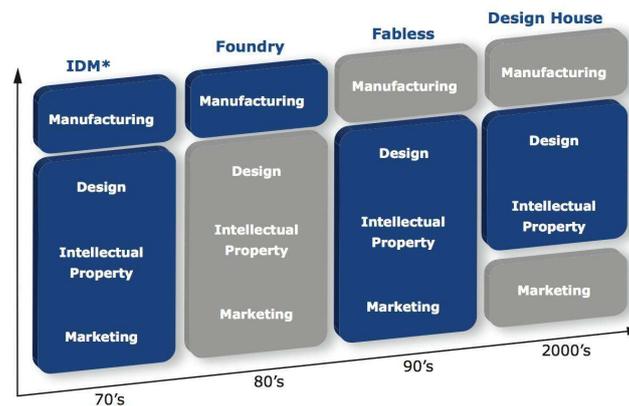
A fabricação de Circuitos Integrados é realizada em Salas Limpas. Mas nem todas as etapas precisam acontecer em ambientes com tanto controle ambiental.



3

Semiconductor value chain deintegration: Business model's historical evolution

(source: Successful Semiconductor Fabless conference, Yole Développement, Mar. 2013)



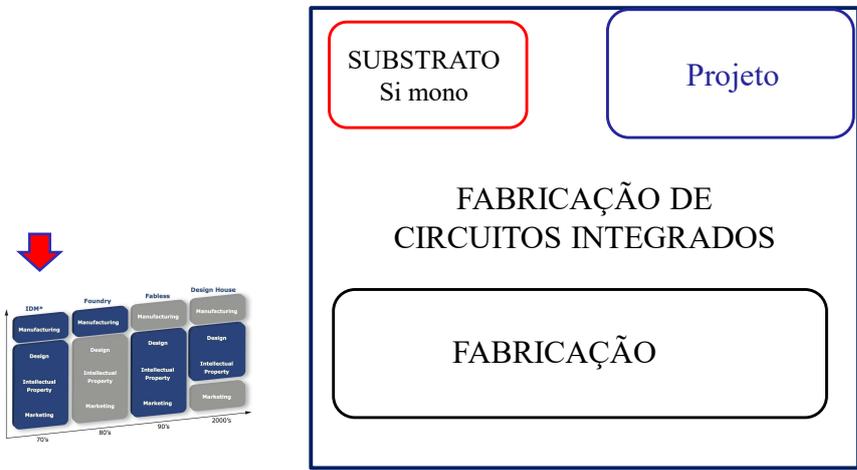
- **IDM*s** are **vertically integrated**; In the **70's**, most companies were **IDM**.
- **Foundries**, focused on **manufacturing**, emerged in the **80's**.
- **Fabless** companies that outsourced manufacturing eventually became **Foundries**.
- **Design house** have emerged in the last decade; Their focus is on IP.

*Integrated Devices Manufacturer

<https://seekingalpha.com/article/4250209-top-3-semiconductor-foundry-stocks-to-buy>

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Nos primórdios da microeletrônica (década de 50), tudo era feito na própria empresa:

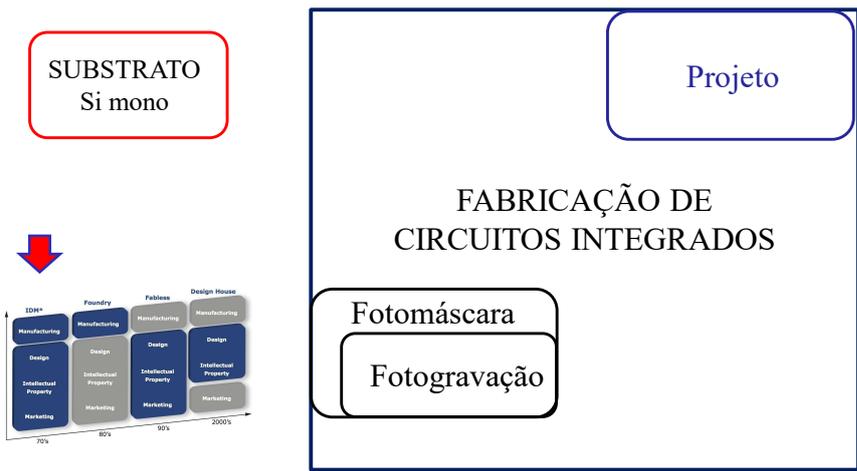


Empresas pioneiras:



5

Posteriormente, numa empresa verticalizada, quase tudo era feito na própria empresa:

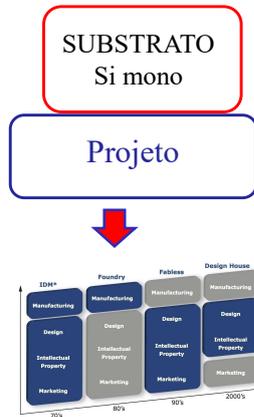


Empresas do tipo IDM
(*Integrated Device
Manufactures*)



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A **FOUNDRY** surge para focar na fabricação do CI, sem se preocupar com a marca (*marketing*), propriedade intelectual e o projeto (*Design*)



Empresas do tipo Foundry:
(somente fabricação)



United Microelectronics Corporation,
Hsinchu, Taiwan, 1980. (Empresa Pública)



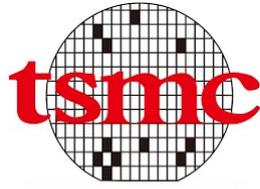
Taiwan Semiconductor Manufacturing
Co., Hsinchu, Taiwan, 1987.
Maior fabricante de CI do mundo!



Semiconductor Manufacturing International
Corporation. Shanghai, China, 2000.



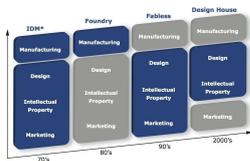
GlobalFoundries Inc.
Santa Clara, CA, EUA, 2006



Taiwan Semiconductor Manufacturing Co.

Maior fabricante de CI do mundo!

A TSMC fabrica o processador A12 para os smartphones iPhone XS e iPhone XS Max da APPLE. O chip é o primeiro chip de 7 nanômetros da Apple e passou a ser fabricado em 2018.



Logic/Foundry Process Roadmaps (for Volume Production)

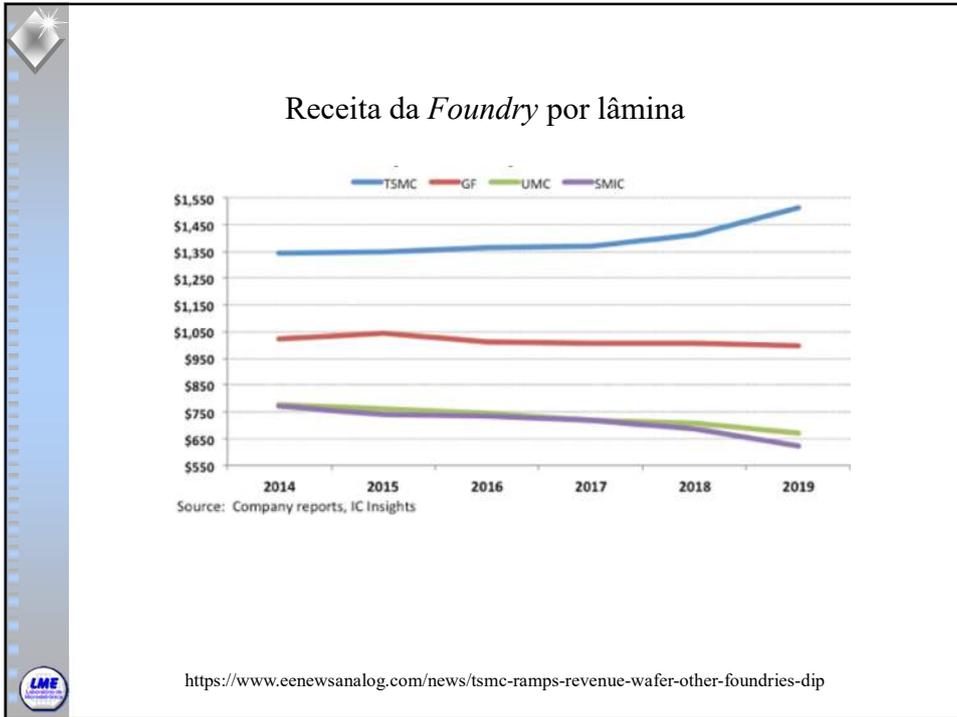
	2015	2016	2017	2018	2019	2020	2021
Intel		14nm+	10nm (limited) 14nm++		10nm	10nm+	7nm EUV 10nm++
Samsung	28nm FDSOI	10nm		8nm	7nm EUV 6nm EUV	18nm FDSOI 5nm	4nm
TSMC	16nm+ FinFET	10nm	12nm	7nm	7nm+ EUV	5nm 6nm	5nm+
GlobalFoundries	14nm FinFET			22nm FDSOI 12nm FinFET		12nm FDSOI	12nm+ FinFET
SMIC	28nm				14nm FinFET		12nm FinFET
UMC			14nm FinFET			22nm planar	

Note: What defines a process "generation" and the start of "volume" production varies from company to company, and may be influenced by marketing embellishments, so these points of transition should only be seen as very general guidelines.

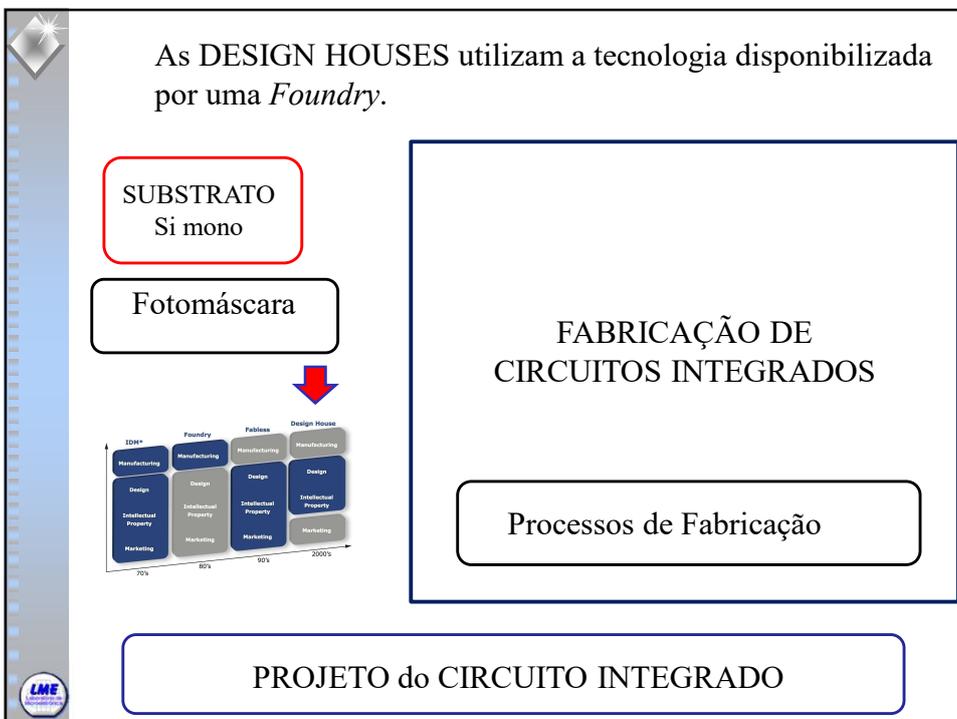
Sources: Companies, conference reports, IC Insights



<https://www.eenewsanalogue.com/news/tsmc-ramps-revenue-wafer-other-foundries-dip>

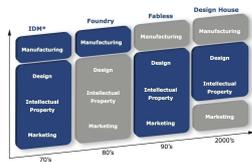


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A partir de abril de 1970, o **LME** (Laboratório de Microeletrônica) trabalha como uma empresa dos primórdios da microeletrônica, no qual tudo era feito na própria empresa:



SUBSTRATO
Si mono

Projeto

FABRICAÇÃO DE
CIRCUITOS INTEGRADOS

FABRICAÇÃO

Caracterização

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Como se faz **Microeletrônica** fora das empresa atualmente:

SUBSTRATO
Si mono

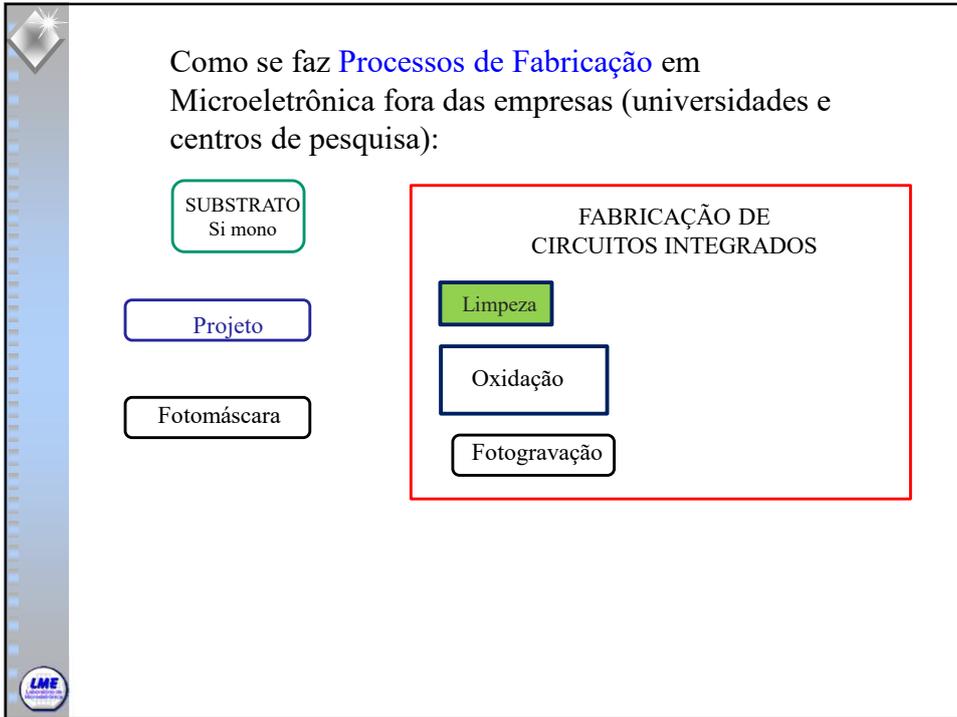
Projeto

Fotomáscaras

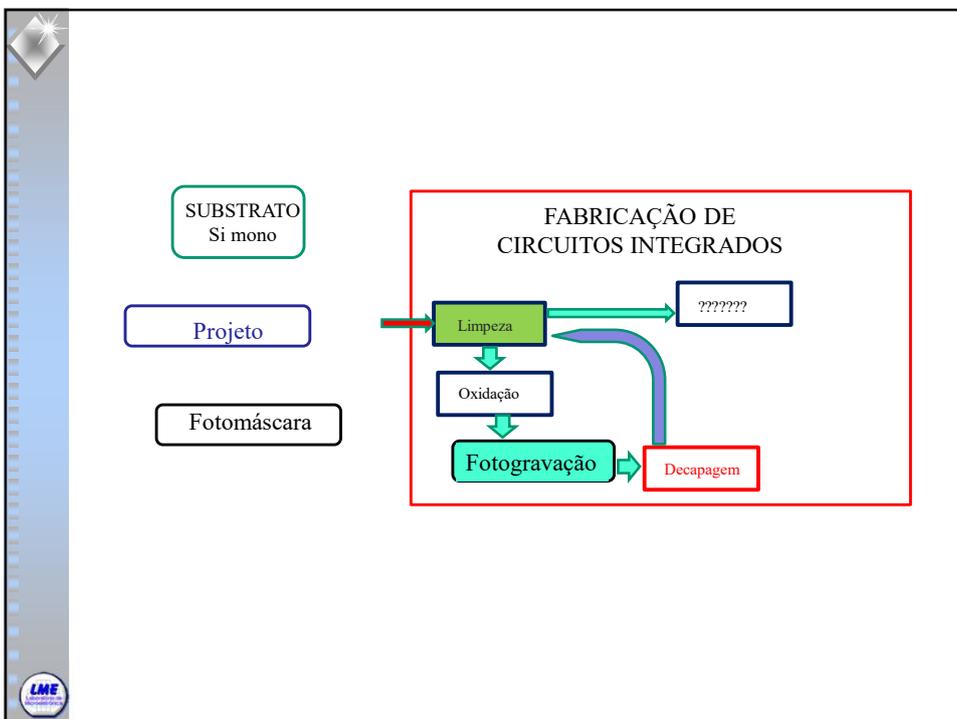
FABRICAÇÃO DE
CIRCUITOS INTEGRADOS

Caracterização

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