Toolkits to Support Product Development by Customers

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Firms often cannot *afford* to develop custom products for smaller customers.
But companies can help all customers design custom products for themselves!

- Customers design chips that are produced by LSI
- User-friendly and integrated toolkit (using simulation and CAD technology)
- Traditional suppliers were reluctant to make tools available to markets (intellectual property)
- Fujitsu even refused to share its tools with US division
The standard, “find a need and fill it” product development model

Solution Information
(“What is possible?”)

Need Information
(“What do I want”)

Supplier

Customers

The toolkits development model

Solution Information
(“What is possible?”)

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Toolkits make sense when collecting accurate Information about each customers needs is costly
Innovation toolkits made many more custom product customers accessible to LSI

LSI toolkits tapped into customers that had not been served

traditional customers

New custom product customers

OLD custom design threshold

LSI’s NEW threshold

Still untapped markets for custom products (still smaller customers)
The Pattern is Repeated: The Rise of Field Programmable Technologies

Next Steps: Where is the New Growth?

- Full custom
- User-designed Chips mfr produces (e.g., LSI)
- Chips that can be customized Design and manufacture By customers in the field
Here is how customers can design and “build” their own custom chips in the field today.

A Verilog Introduction for Hackers
By the Sun Feb 29th, 2004 at 09:23:14 AM EST

“Designing your own chips, the silicon variety. That's something you do with millions, if not billions of dollars of equipment and large fabrication plants under ultraclean conditions.

Well, isn't it? Actually, no. You can design your own chips at home with a PC using no more than about $50 of equipment and I'm going to tell you how to do it with the absolute minimum of effort.
Why ASIC customization is cheaper with toolkits

- For custom design projects, manufacturer information is standard from project to project but user need differs

Example:
- Each ASIC design tends to require the same information from the ASIC manufacturer, but unique information from the ASIC user.
Exercise: Planning a toolkit for your company

1. Identify a type of product your firm manufactures where user demand for customization is strong.

2. Think of design tools within your firm that could be used as the basis for a “toolkit for user innovation” for that product type.

3. How would you adapt the basic product type to separate out “need-intensive tasks” for user customization?

4. Describe what a “user-friendly” toolkit for user innovation might look like for this product type.
How do you design a toolkit?  
There are two major tasks

A. Separate out development tasks that are custom “need-information-intensive” and assign those to users.

Impact on Product architecture can be major
  - Custom cake vs custom pizza;
  - “Full-custom” IC vs custom ASIC

B. Develop the tools users need to carry out the need-intensive tasks assigned to them.
You might have to change the basic design of your product to enable toolkits your customers can easily use

“Full-custom” IC Design vs “Gate Array IC Designs”
(B) **Toolkits for users contain:**

Tools to carry out trial-and-error design:

1. That are “user-friendly”
2. That offer the right “solution space”
3. That offer libraries of pre-designed modules
4. That can translate from user-language to producer language without error
Toolkits should help users to do the trial-and-error work of problem-solving in design

- **Design**
  - Design a possible solution

- **Build**
  - Develop models prototypes

- **Run**
  - Test model/prototype In real or simulated use environment

- **Analyze**
  - Analyze findings previous step

Done
Tools to enable user to carry out design by trial-and-error

Four steps in trial-and-error-process:

- **Design**
  - ASICs example: Design custom circuit
- **Build**
  - ASICs example: Create functioning prototype
- **Test**
  - ASICs example: Take prototype for a “test drive”
- **Analyze**
  - ASICs example: Compare expected and actual results. If needed, do trial-and-error cycle again. (“Iterate”)
In some cases, visual images are good enough for simulation of solutions. For example, “everyone knows what a watch is and does – so a picture is OK”
(1) Offer “user-friendly” tools

“User-friendly” means that the user does not have to learn a new design language.

Learn what your CUSTOMER’S Language is; Translate your internal language into that customer language.

Example: Barbie hairstyler provides users with “user friendly” tools to create the look they want.

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User-Friendly Flavor Design Toolkit for Users
To simplify the user’s design task, display only information of use to the user

- Identify the independent design dimensions that are important to the user.
- Give each design dimension a user-friendly name
- Create a translator – hidden from the user – that translates each move by a user-designer in user solution space to a move in manufacturer solution space. (Flag the user when a user move can’t be done in manufacturer solution space.)

**User Map:**

- Degree of Jamminess
  - Low
  - High

**Supplier Map:**

- Range of Flavor
  - System A
  - System B
(2) Offer the right “solution space”

- Toolkits must offer users a “solution space” that contains all the design variables and tools they need to create a design.

- Example: Hairstyling toolkits:
  - Design variables offered: hair position, length, color, waviness;
  - Tools offered: virtual scissors, comb, colorants, curlers, straighteners.
(3) Offer pre-designed modules

- Custom designs are typically not totally unique. Toolkit libraries should contain pre-designed modules and modifiable “default designs” – so that users can concentrate their design work on the novel features of their designs.

- Examples:
  - “Macrocells” for custom IC designs: microprocessor
  - Modifiable “default designs” for hairstyles or for houses.

- Modules should make “design sense” to a user-designer. (e.g., not “half a roof plus front door” for house designers, or “sautéed garlic plus onions” for chefs)
(4) Toolkits must enable “first-time,” error-free production of user designs

- User design language provided by toolkit must translate to production language without error:
  
- **Sometimes this is easy:**
  
  - Translation from circuit design language (Boolean algebra) to IC producer’s digital device fabrication language.

- **Sometimes this is hard:**
  
  - Nestle Mexican Sauces toolkit
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Can you profit from toolkits?

- Users will benefit from toolkits in your industry if user needs are heterogeneous.
- If users will benefit, you must offer toolkits – or someone else will and get first mover advantage.
- Your business model may change when you offer toolkits – for better or for worse.
- Example: ASIC foundries profited from a toolkit approach for the first 15 years – and then began to lose profit to specialist toolkit suppliers.
How to start developing a toolkit

- It’s OK to start with something rough as long as it offers sufficient value to entice user experimentation.
- You don’t need superhuman insight to design and update toolkits – lead users will bump up against the edges of the solution space your toolkit offers and ask for more – or design toolkit improvements for themselves.
- Work with lead customers that really need your toolkit and so will be willing to work with you as you refine it.