





## Technological fungibility

Combining and recombining technology in different ways to create different kinds of products

New Ventures

Welcome back to week two, this is segment 2.1 "Linking Technologies and Markets: Key Issues," and in particular, we're going to talk about products and underlying technologies. - Here with me is Chris Tucci. - Thanks. It's another upgrade in the height department here. - Looking very tall today. - Yeah, we're alike. So what we will be doing today with this segment is to introduce you to the term technological fungibility and what it actually means for the creation of high tech ventures.

Notes

Summary



0m 00s

## Week 2: Identifying & Evaluating Business Opportunities

Launching New Ventures: Entrepreneurship & Strategy for Technology-Driven Startups

Prof. Chris Tucci and Prof. Marc Gruber

When you think about that in more detail, this is explained very well on this slide. Technologies can be combined with other technologies to form products. So underlying a product are different sorts of technologies, but when you recombine these technologies - you see it here, technology B, and C, D, E, and A - when you recombine these elements, you might be able to create another type of product which then can cater to another set of end customers. This is the whole logic of technological fungibility that we have discussed in management since the 1950s, which means one: sets of technologies can serve multiple markets, so, from a technology entrepreneur's perspective your underlying competence in a technology can actually be used to cater to multiple market domains. And that's beautiful because many of these domains might be better than the one that you thought of. (Chris) So in this particular graphic here then-- so this product is based on A, C, E and D-- Exactly. ...and E is also used in the second product over here, and B is also used in this third one, along with D. (Marc) Exactly, that gives you a lot of flexibility in your venture creation because you can say: "My technology is fungible and it can render purposes for multiple sets of customers."

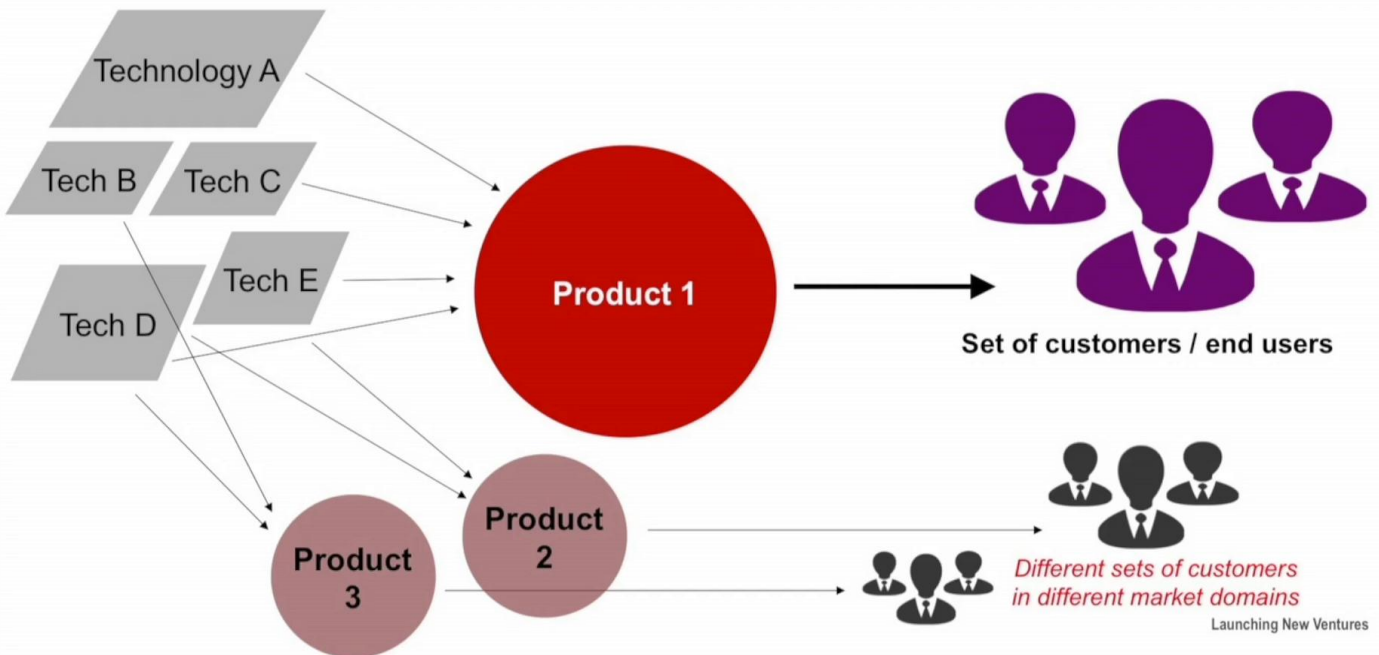
Notes

Summary



0m 00s

# Anatomy of a product



What the interesting point is - we will come back to it later in another segment - is that all these end customer markets typically have different properties. Some of these markets will be better ground, more fertile ground for creation than others. We will discuss that in a separate segment, but that's beauty of having fungible technologies or fungible competence in that sense.

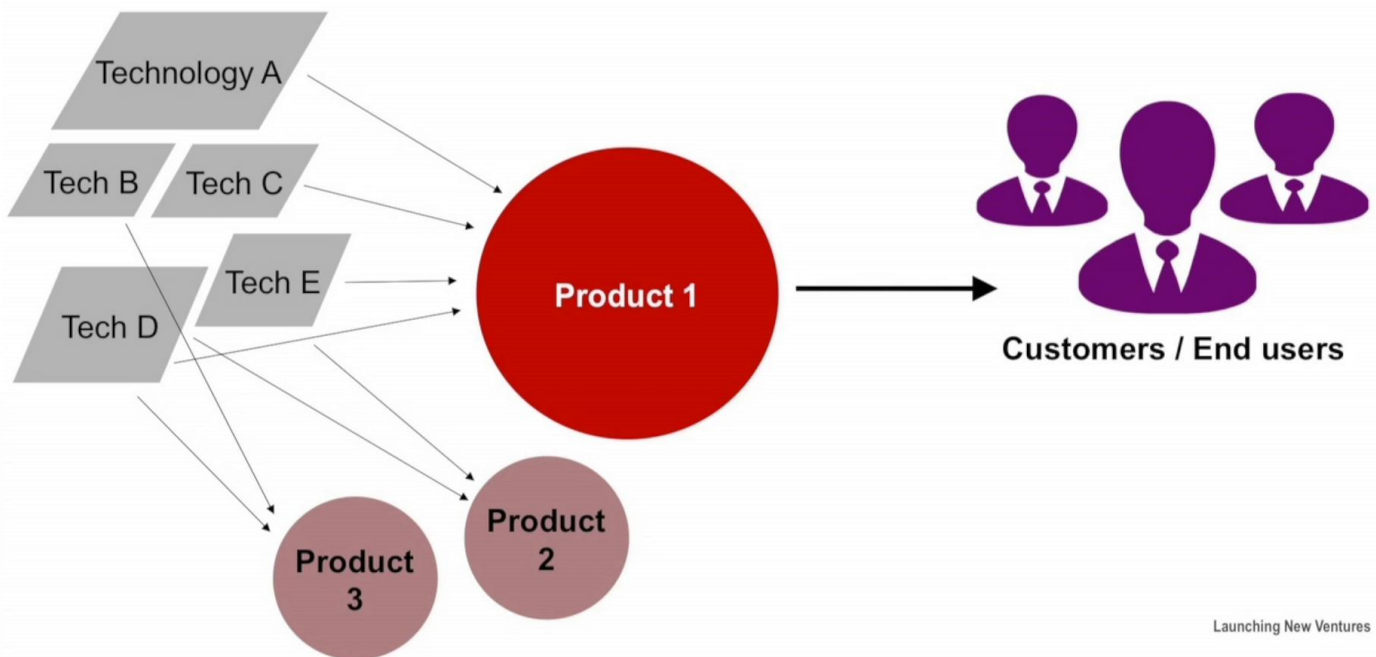
Notes

Summary



1m 45s

# Anatomy of a product



We start here thinking about technology, but you can also start here on the right-side with thinking about an end-user customer and say OK, in order to cater to that end customer, you need to develop a product with underlying technologies, but once you're working on the technologies, you might have the idea that this could actually be used to serve other end customers, if we have different sorts of products. So the independent way actually starts on the right-side here, on the left side, this is a process that gives you flexibility as an entrepreneur, and that is something where you as an entrepreneur can have a lot of impact on how your firm is created and how your firm ultimately will look like.

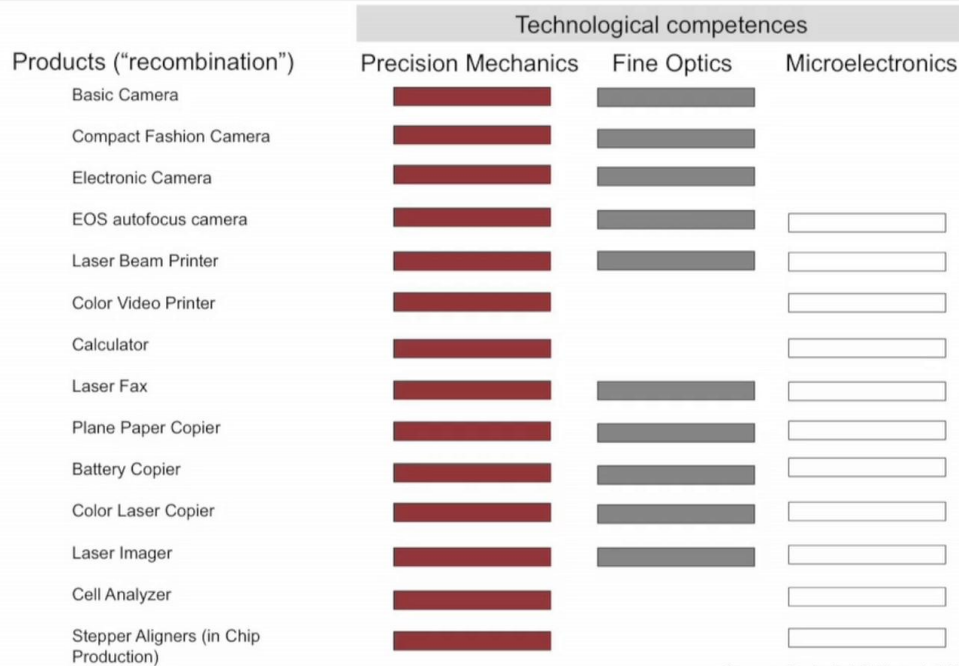
Notes

Summary



2m 06s

# Example: Canon



Source: Prahalad & Hamel, 1990

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Let's look at a concrete example here. This is Canon, a company that makes different kinds of camera devices. This is the classic story from the Prahalad and Hammel article from years ago, that basically shows that they have expertise in certain areas, precision mechanics, fine optics, and microelectronics. Looking at this graphic more closely, you can see that for a basic camera here, you just need precision mechanics and fine optics.

Notes

Summary



2m 43s



## Linking Technologies & Markets: Key issues – Products & Underlying Technologies

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These precision mechanics are going through everything that they're doing, so we just think about this column here, this is really covering everything. Then there are certain other combinations with things that enable them to make specific products. If you think about microelectronics here, for example an autofocus camera, requires all three of these different kinds of competencies. (Marc) And that, if you move back to the last slide and think about it, that is exactly technological fungibility. You have precision mechanics as one technological competence you combine with other types of competences and then this provides you with a different type of product, and this can render a different type of service. So, you can think of your company as possessing competences, this is a young company that possesses competences, of course, you want to develop some others but you have competences as well, and these are fungible, and it's not God-given that you only focus on one product with one market domain attached to it, there could be lots of opportunities. (Chris) In fact, here you can see there are certain other things that are quite different from cameras; the laser fax, for example, or a plain paper copier, it's not exactly the same market as the cameras.

Notes

Summary



0m 04s



# Example: Canon

Products ("recombination")	Technological competences		
	Precision Mechanics	Fine Optics	Microelectronics
Basic Camera	<div></div>	<div></div>	
Compact Fashion Camera	<div></div>	<div></div>	
Electronic Camera	<div></div>	<div></div>	
EOS autofocus camera	<div></div>	<div></div>	<div></div>
Laser Beam Printer	<div></div>	<div></div>	<div></div>
Color Video Printer	<div></div>		<div></div>
Calculator	<div></div>		<div></div>
Laser Fax	<div></div>	<div></div>	<div></div>
Plain Paper Copier	<div></div>	<div></div>	<div></div>
Battery Copier	<div></div>	<div></div>	<div></div>
Color Laser Copier	<div></div>	<div></div>	<div></div>
Laser Imager	<div></div>	<div></div>	<div></div>
Cell Analyzer	<div></div>		<div></div>
Stepper Aligners (in Chip Production)	<div></div>		<div></div>

Source: Prahalad & Hamel, 1990

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Therefore, it can be used to combine, make different things, and attacking different markets. (Marc) Looking into the future of this MOOC, these types of product markets that you're looking at here have different types of features. Some are growing, some are declining, some [inaudible] are growing from creation than others. Of course this is a larger company, but here we only try to make this point that technologies are fungible and can cater to multiple domains.

Notes

Summary



4m 27s



## Example: Space Shuttle Heat Shield Tiles



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So let's look at another example, it's a famous example, it's the heat shield tiles from the space shuttle. It's a ceramic that is used to protect the space shuttle when it reenters the orbit from going up in flames. Because bad things happen and they fall off. But the main point that we want to make is this ceramic has certain properties, it can be used to protect the space shuttle. But how many would you sell? You'd probably sell 10,000 for a space shuttle? Times four space shuttles when they're still flying. So you're starting at an overall 40,000. This is a limited market - it's a cool market of course - but it's limited. So if you are creating a high growth venture, you might want to ask yourself, is this the right market to create that type of growth that I'm aspiring to? If you look at it, it might be a stepping stone to something bigger and better, but it's not the growth market that will allow you to grow your company into a billion dollar enterprise as such. So thinking about this ceramic in a bit more detail, that there are other applications that arise. Let's look at those.

Notes

Summary



4m 50s

# Analyze your opportunity

- How large is the market?
- How competitive is the market?
- Which market is most fertile?
- Does it match my growth ambitions?
- What does it mean for my organizational identity?  
...and my venture's relationships?



Product 1



Product 2



Product 3

So to analyze this you might want to ask yourself, what application areas could this technology be used in? We did a little brainstorming here, the first three things that we thought of: it could be used in catalytic converters, for example in a car, it could be used in refrigerators, and maybe used in chimneys. So while each of these may be better than selling a limited number to a small number of space shuttles, they may have very, very, quite different characteristics to make them attractive to the entrepreneur. So the catalytic converter sounds very good because it could be a huge market. On the other hand, competition could be very intense in the auto parts supplier industry. So there's a big market with a lot of competition. You may have less competition in refrigerators, maybe a bigger market in chimneys, etc., so you go through this one step at a time, trying to analyze what's the best place to put my technology in terms of the opportunity space.

Notes

Summary



5m 59s

# Analyze your opportunity

- How large is the market?
- How competitive is the market?
- Which market is most fertile?
- Does it match my growth ambitions?
- What does it mean for my organizational identity?  
...and my venture's relationships?



Product 1



Product 2

Product 3

Exactly, and what's particularly intriguing, if you think about it, is that you're not only selecting the most fertile ground for fund creation - some markets are more favorable than others - but you're also shaping the identity of your company, what we call organizational identity. Because if you think about it, if you cater to the aerospace industry, your company will be looking quite different than if you cater with your technology to the chimney market or the refrigerator market. You will be hiring different types of people, different people will find your company good to work for when you're working with the aerospace industry, and some others might say, I want to work for a refrigerator company. You have different sorts of supplier and distribution relationships. Altogether they are shaping who you are as a company, and that's a very fundamental question beyond the performance question. Thinking about this in a structured way, this is maybe one of the most important and fundamental decisions that you ever will engage in in your early entrepreneurial journey. So in that sense, it's worthwhile looking at that in more detail, as a process of re-linking and de-linking. So let's do that.

Notes

Summary



6m 58s

Innovators often link their *technology* with a specific *market application*.

In order to understand the technology leveraging *potential*, the *technology* and its *market application* have to be *decoupled*.



Source: Danneels, 2007

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So this process can be conceptualized as a process of de-linking and re-linking. We're going to explain to the user that process in the next two slides, but let's do it one by one. Oftentimes, when you think about it, technology is developed with a purpose, meaning there's a market idea oftentimes in the mind of the entrepreneur.

Notes

Summary



8m 04s



Innovators often link their technology with a specific market application.

In order to understand the technology leveraging potential, the technology and its market application have to be decoupled.

## I. Close Linking between Tech and Market

## II. De-Linking: Understanding Technological Resource in its own right

- Where is it general?
- Where is it specific?
- What is unique? How can it be adapted, expanded?
- What are potentially valuable components?



Source: Danneels, 2007

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So there is often times a close link between technology and market. Because it's oftentimes the starting point, you have to engage in another step in order to understand the spectrum of possibilities that is awaiting you with the technology. (Chris) So that would be like de-linking the process step. So you want to understand the technological resources in their own right. So when is this technology general? When is it specific? What's unique about it? How could it be adapted, changed a little bit, moved around, expanded? What are some of the components of it? How can we use this technology? So we're trying to be a little bit more open minded, even though you start with something in mind, you might want to then analyze how it could be used in other places. (Marc) Think about this [precision scope] that we spoke of. Think about the Canon example. Think about these competences in their own right. What can they do? What are the properties of them? So you have to decouple the technological resource, in a way, from your market application, so you cut them. Think about the technology that they're coupled with.

Notes

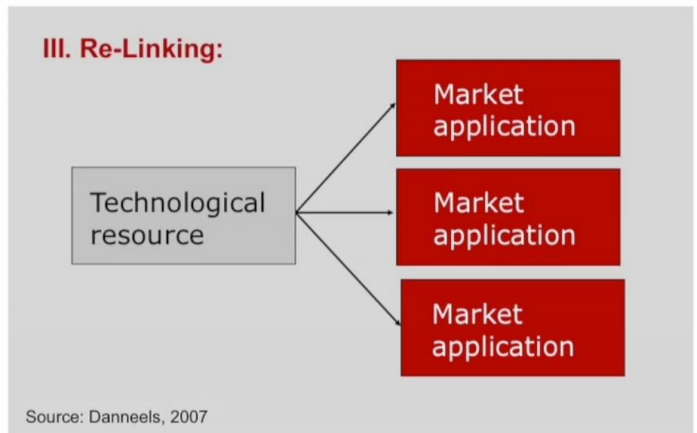
Summary



8m 21s

De-linking is the essential basis for understanding the underlying scope of a technology

The search for market opportunities requires additional capabilities



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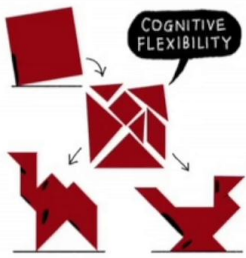
In the next step then, you would say, "I relink my technology with other possible market applications." So it's the basis for understanding your application spectrum, but it also depends on whether you can see other opportunities. That's also not a given, it means you have to go out there and try to understand where can it be applied. If you look at this type of problem, which is a very interesting one, and a very rewarding one if you are successful at it, - in the next segment - but for now, think about this as a process of de-linking and re-linking, because then you can understand your company, the basis of your company creation in a more systematic way.

Notes

Summary



9m 22s



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I think it's part of the entrepreneurial mindset in some ways to try and imagine other uses. I think a lot of people come up with something that's technology and then become fixated on the first application they think of. Whereas, what this is encouraging us to do is to really think that through to try to think of the other applications. That's quite an important point because there's tons of research that actually shows that those people who are really good at entrepreneurship have this cognitive versatility. They can look at stuff from different angles and can try to understand where it fits best.

Notes

Summary



10m 02s



# Goal: Identify the "Killer Application"



*It's easier said than done!*

## CFRP (carbon fiber-reinforced plastic):

- Developed in the 1950s
- True "killer application" in sports gear identified only after **15 years**
- Production and cost factors prevented widespread adoption
- Mechanical failures (e.g. airplane crashes) slowed adoption

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So this wheeling and dealing should lead you to fully find attractive opportunities and what we call the "killer application" not in a negative sense, it's in a positive sense. Because it should be the application where you potentially can earn most of the money. - It takes over the whole market. - Exactly. Where you have the opportunity to kill the competition. (laughing) So let's look at one, this is carbon reinforced fiber, it was also developed for NASA to protect and house the satellites in space with a slim material that doesn't weigh a lot. This was developed in the '50s, but it took 15 years until someone actually figured out that the "killer application" would be sports equipment. Nowadays, it's used in all sorts of sports equipment, but it just took so long. So if you think about this type of problem that we're discussing right now, If you are really good at identifying opportunities this has huge potential for you in firm creation, because it means you might be the first one to identify these really cool applications that will allow you to grow as a company.

Notes

Summary



10m 31s

## Two-fold importance

**1** Market opportunity:  
this is the “**fertile ground**”  
on which you build your  
venture



**2** It shapes the identity of your  
venture

- Who you are as a company
- How others see you
- How you view yourself



*In other words, this is one of  
the **most profound decisions** you will make as an entrepreneur.*

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So in sum, when you think about it, it has a two-fold importance for one, the market opportunity provides you with the fertile ground on which to build your venture-- - And it also shapes the identity of your firm, who you are as a company, how others see you, how you see yourself, so it's really one of the most important decisions you're going to make as an entrepreneur.

Notes

Summary



Hence it is important to understand:

- Which market opportunities you can “see” as an application of your technologies
- ...and which you **can't**...

The latter is often the more interesting question!

*This will be the topic of the next segment.*

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(Marc) So in order to identify the "killer application", you want to see which opportunities are out there. This is not trivial. I think the interesting question is which opportunities can't you see at first? What can you do in order to see more of that opportunity space that is waiting for you?

- Notes

## Summary





And this will actually be not today's topic-- ...but the topic of the next segment that Marc's going to walk you through. So this will be 2.2, and I see you then.

Notes

Summary



12m 11s