Combination of Contradictions Based approach and Logistic Curves models for Strategic Technological Forecasting

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what is right problem to be solved?

TWO GENTLEMEN'S STORY

Sir Christopher and Sir James are walking along the Thames. Suddenly they see a child in the water calling for help. Sir Christopher jumps into the river and saves the child. As soon as he gets back to the shore he hears another child crying for help. The gentleman jumps back into the river and keeps saving the children as the situation repeats itself several times.

Finally, Sir Christopher feels absolutely exhausted and asks Sir James why he doesn't help him save the children as he can barely keep on water having saved the children for some time. Sir James looks at him and replies that he thinks he'd better go up the current and see who is throwing children into the river.

restless question…

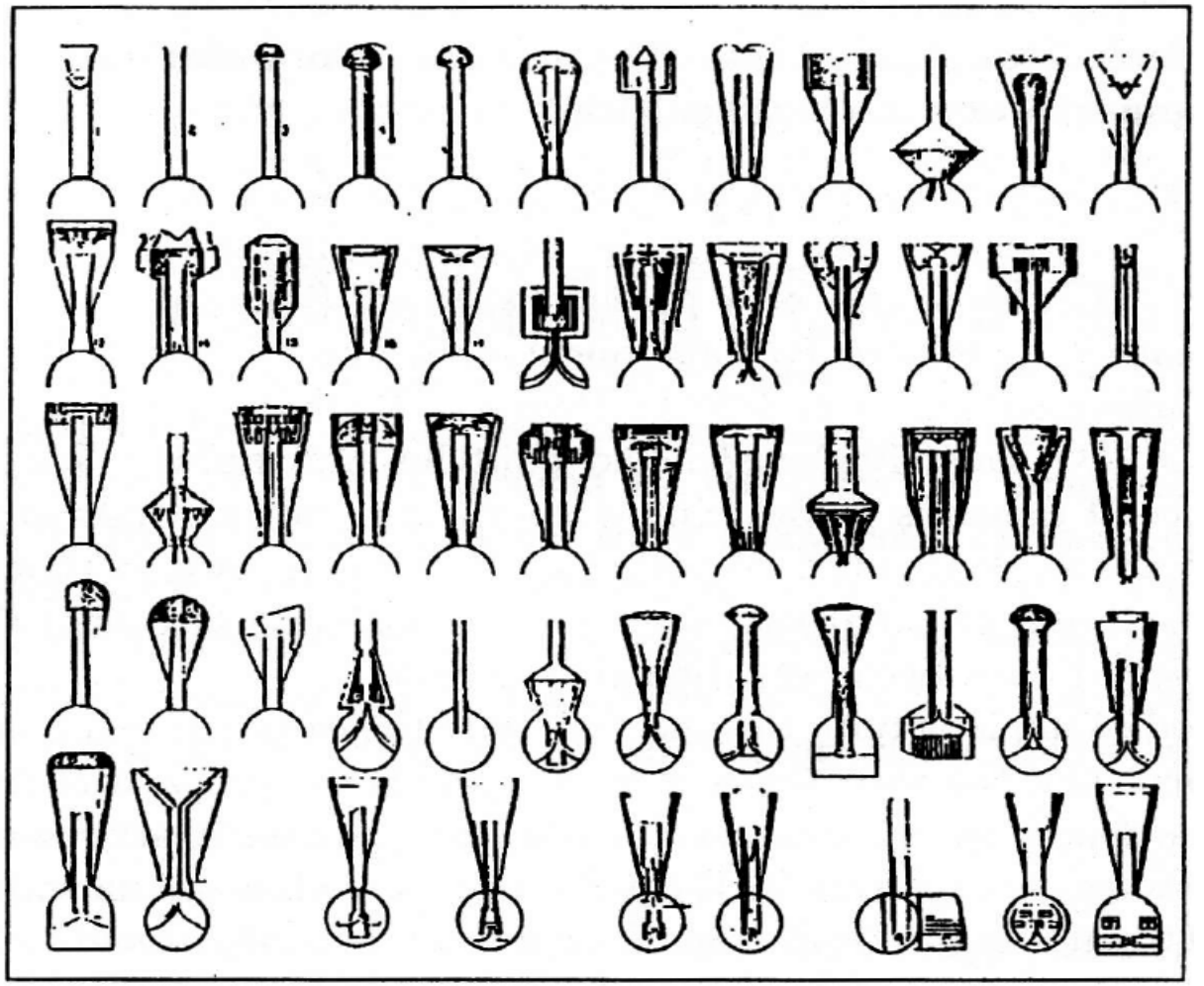
…The righter we do the wrong thing, the wronger we become…

Russel Ackoff (2003)

what is a reason that so many patented *inventions* have not appeared as *innovation*?

Some examples out of a thousand patented 'smoke-spark arresters' for wood-burning steam locomotives in the USA (19th century).

Source: Basalla, G. The Evolution of Technology, p. 136. Copyright © 1988



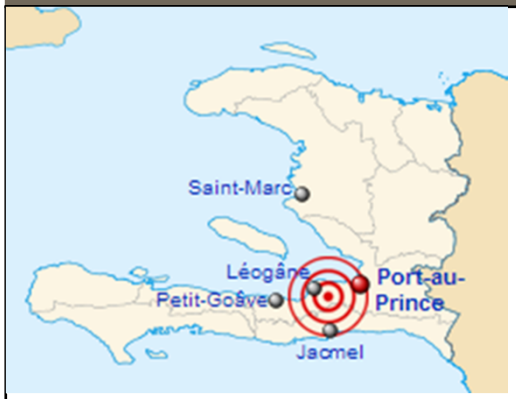
* Source: Grubler, A. Technology and Global Change. (International Institute of Applied System Analysis, Cambridge, 2003), p.452 ISBN 0 521 54332 0.

Steam locomotive (spark arresters)

Source: https://en.wikipedia.org/wiki/File:California_Western_Railroad_Locomotive_45.jpg

two earthquakes

Haiti, January 2010



On 10 February the Haitian government reported the death toll to have reached 230,000*
An investigation by Radio Netherlands has questioned the official death toll, reporting an estimate of 92,000 deaths as being a more realistic figure.**

* "Haiti quake death toll rises to 230,000". BBC News. 10 February 2010.
** Melissen, Hans Jaap (23 February 2010). "Haiti quake death toll well under 100,000". Radio Netherlands Worldwide. Retrieved 28 February 2010.

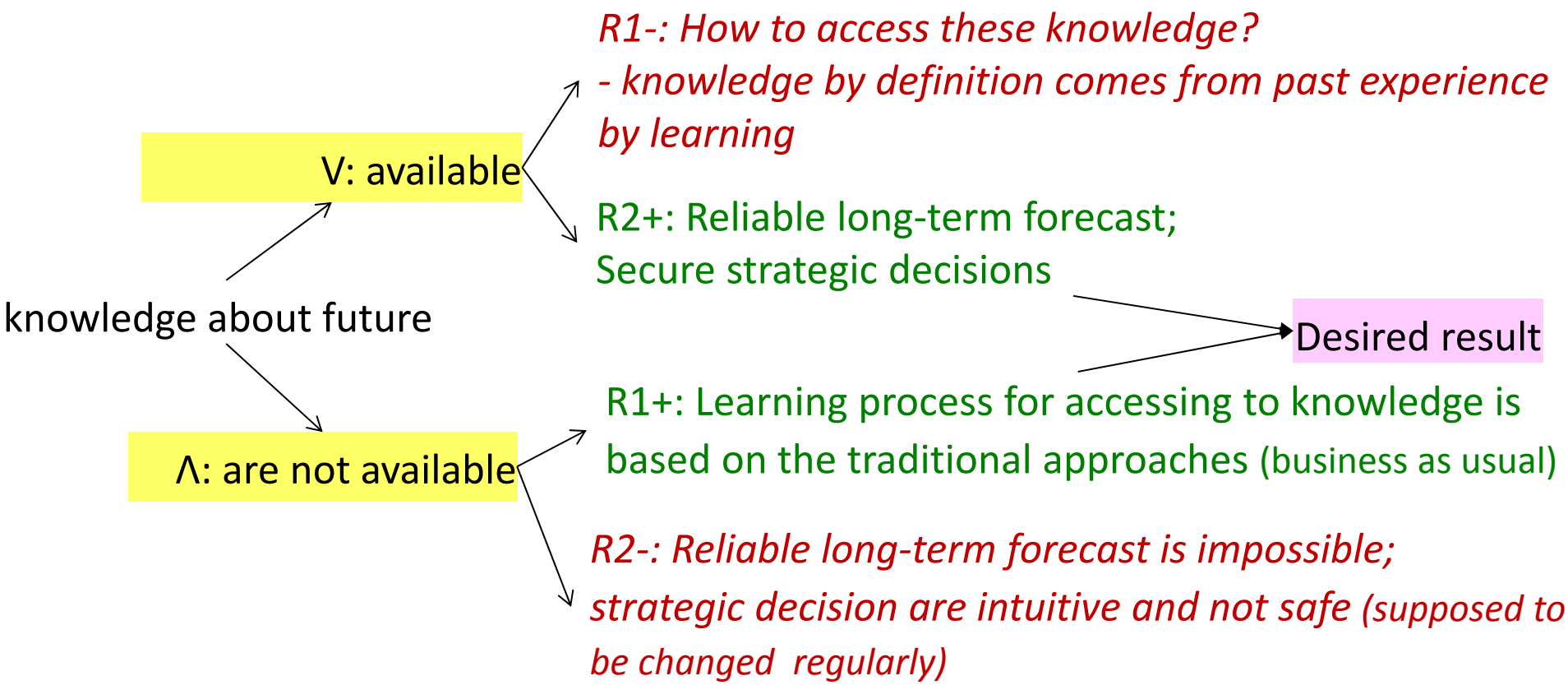
Chile, February 2010

This was the strongest earthquake affecting Chile since the magnitude 9.5 1960 Valdivia earthquake (the most energetic earthquake ever measured in the world).
…as the **seventh strongest earthquake** ever measured, **five hundred times more forceful** than the 7.0 Mw earthquake in Haiti in January of 2010.

The latest death toll as of April 7, 2010 is **486 victims*****

*** Gobierno aumenta a 486 los fallecidos por terremoto y posterior tsunami http://www.latercera.com/contenido/680_240084_9.shtml

why is it difficult to forecast?



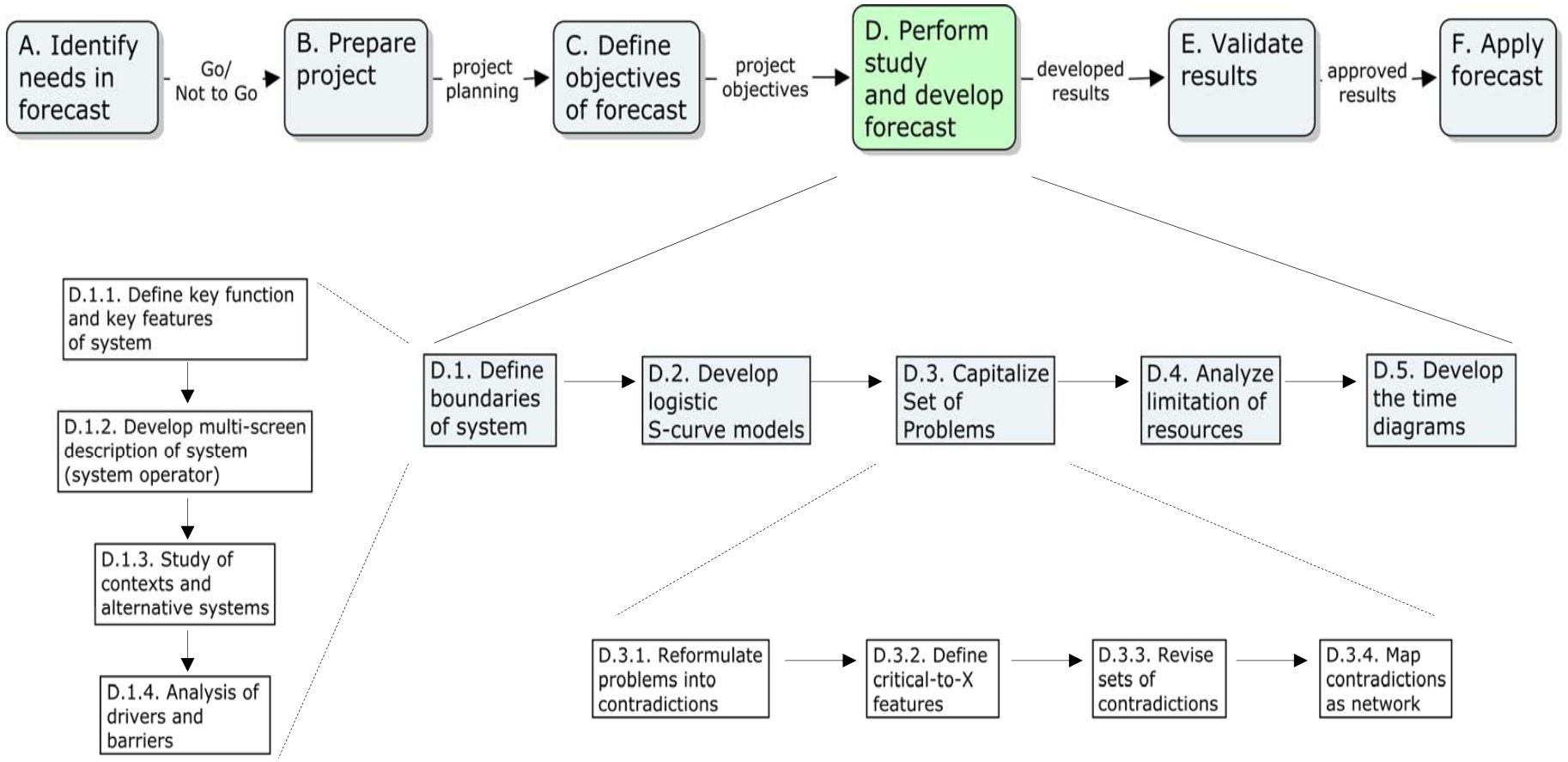
what is suggested?

Problems are more important than solutions. Solutions can become obsolete when problems remain.

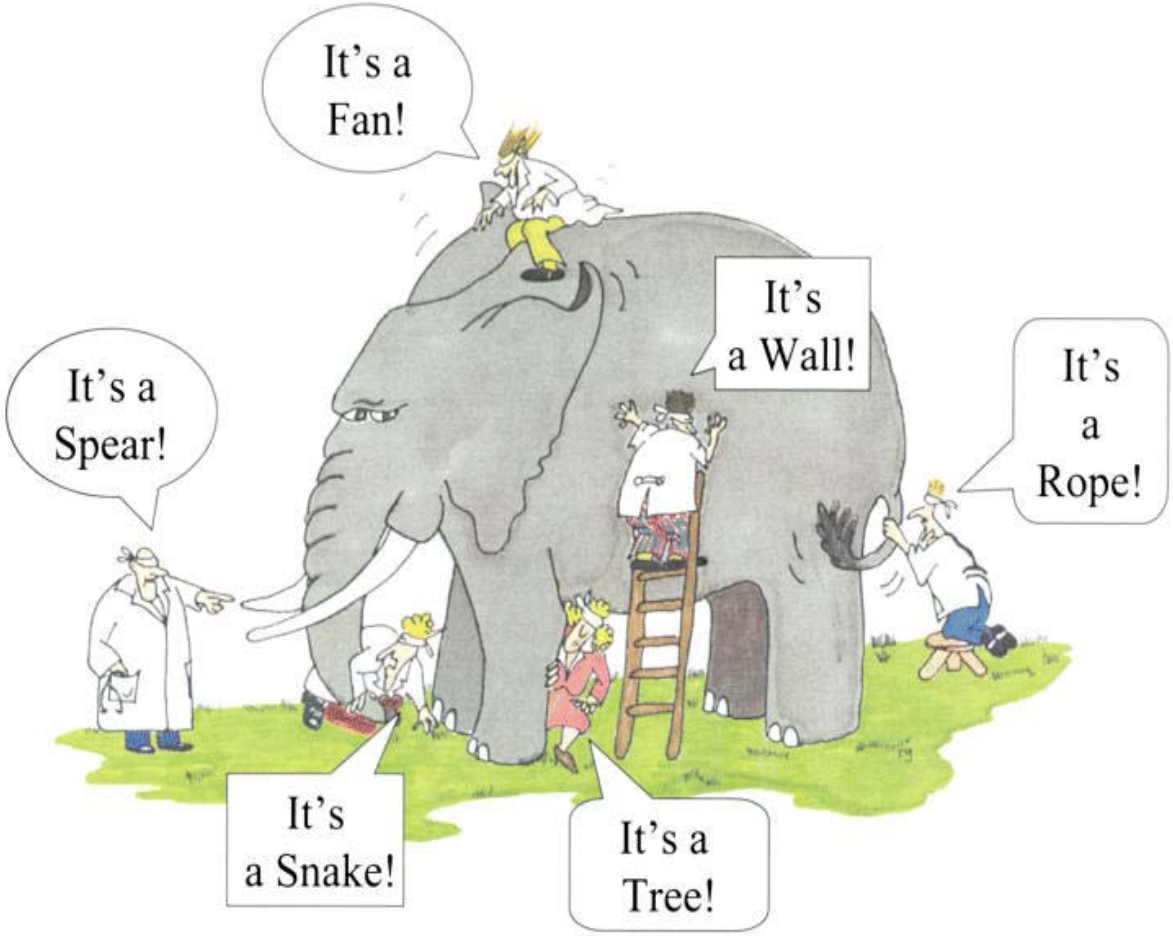
– attributed to Niels Bohr

Researching Future methodology (RFm)

main function: <facilitate> <the collective production of knowledge> (about future)

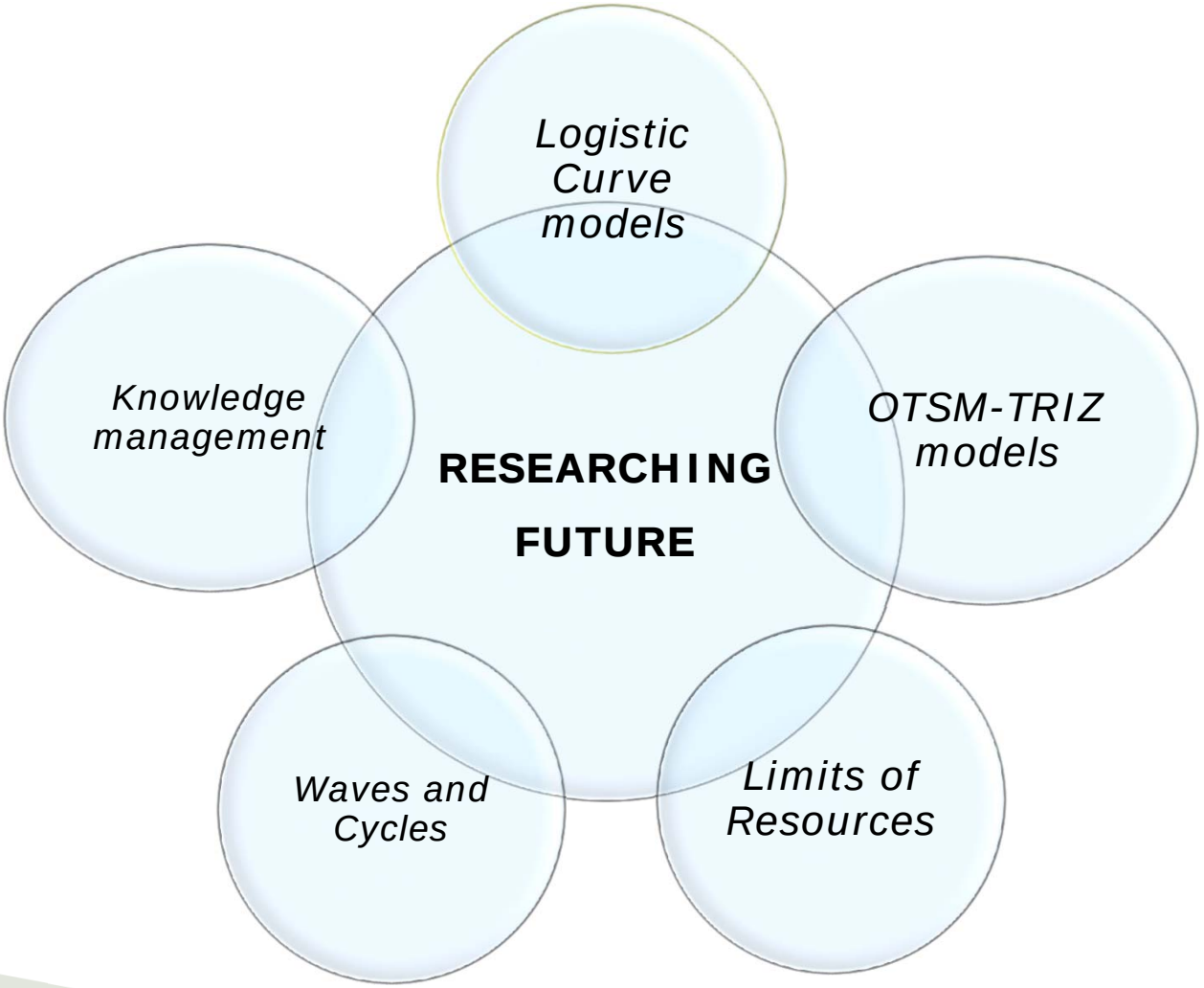


why collective production of knowledge should be facilitated?

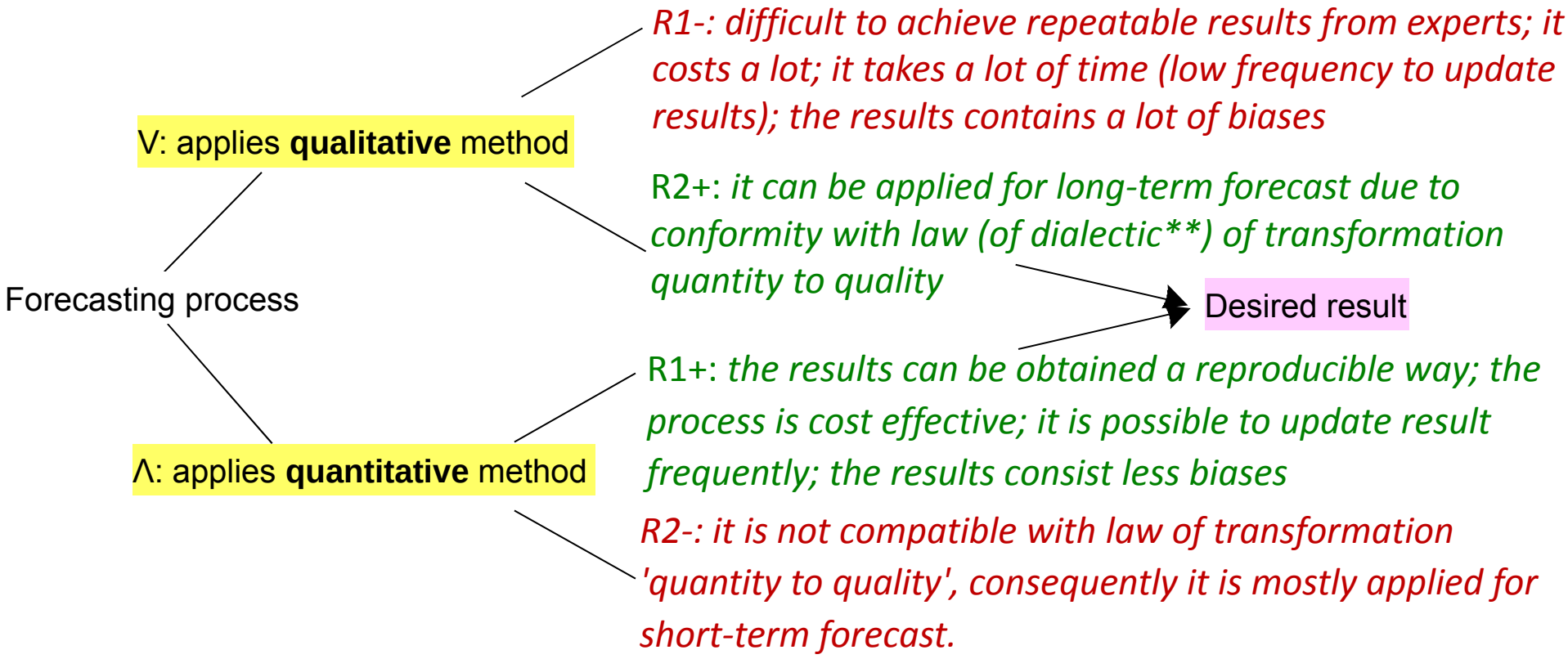


Source: www.whattofix.com/images/BlindMenElephant.jpg

Researching Future methodology (RFm)



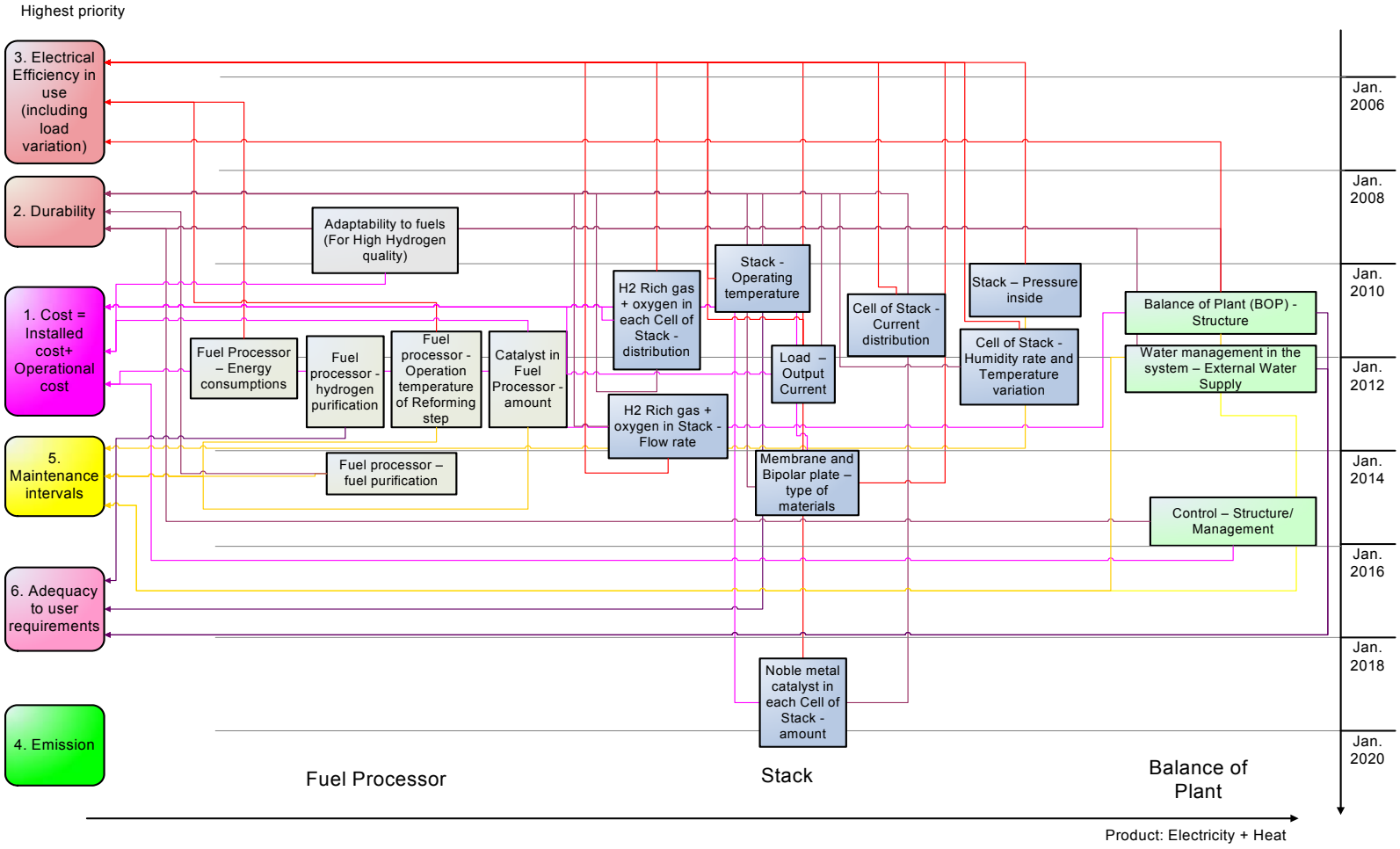
the problem of a method for exploratory LONG-TERM forecast



** The law of transformation of quantity into quality: *"For our purpose, we could express this by saying that in nature, in a manner exactly fixed for each individual case,* ***qualitative changes can only occur by the quantitative addition*** *or subtraction of matter or motion (so-called energy)."* [Engels' Dialectic of Nature. II. Dialectics. 1883]

network of contradiction as a roadmap

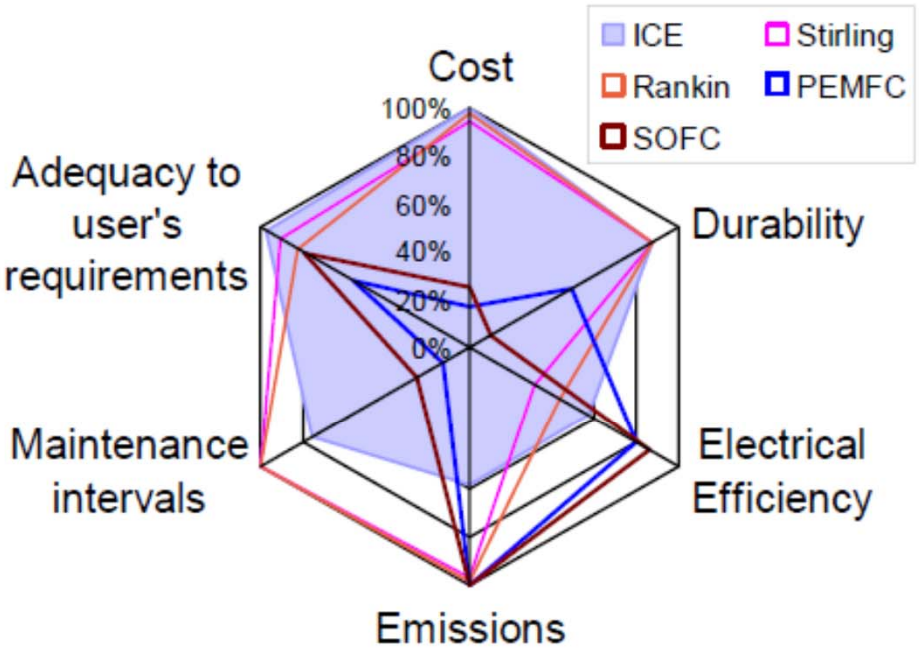
Source: Information provided courtesy of EIFER, Karlsruhe [Gautier, L. et al., 2005]



features of future

Source: Information provided courtesy of EIFER, Karlsruhe [Gautier, L. et al., 2005]

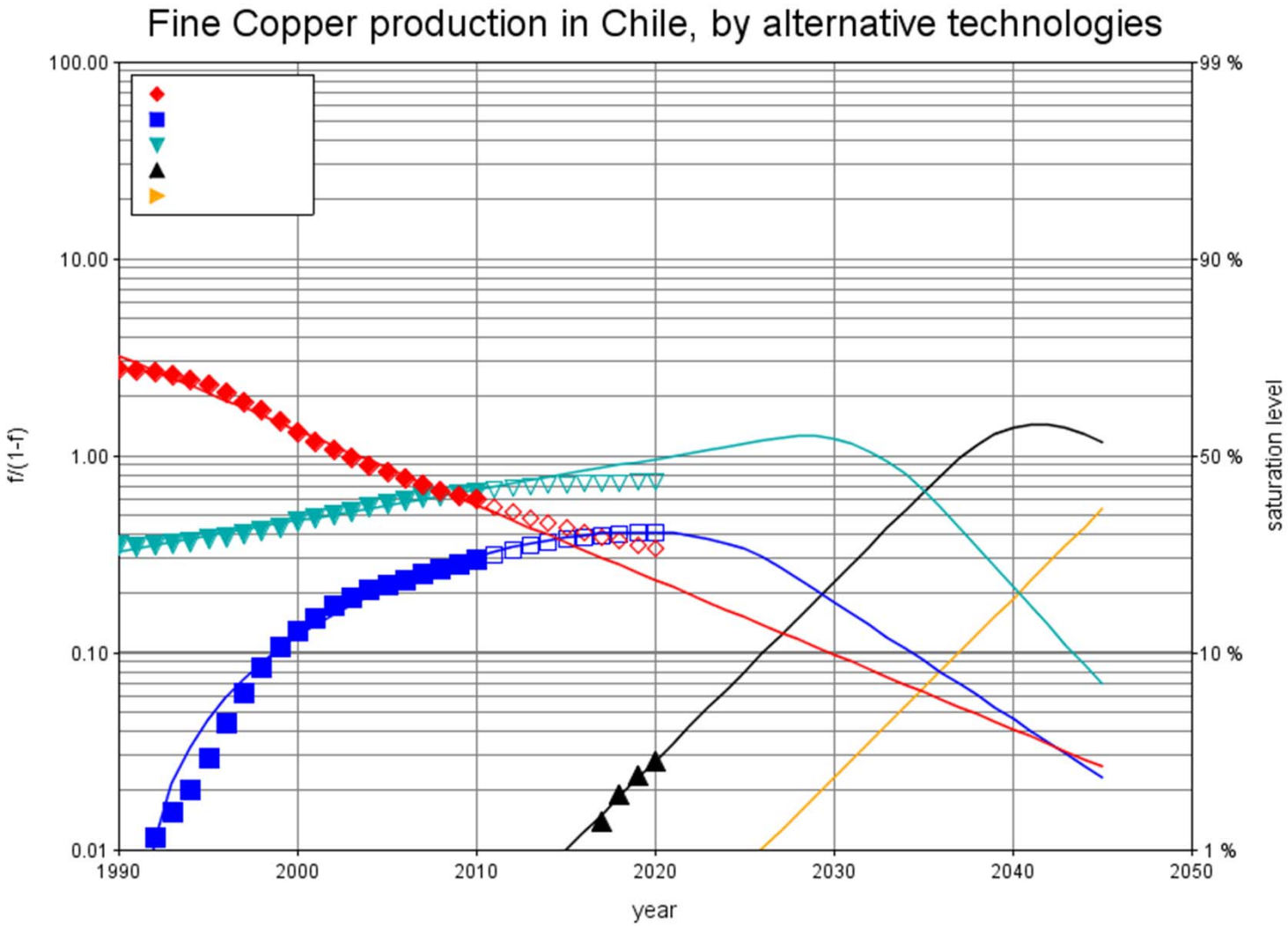
Critical-to-Market features: Stationary Fuel Cell



		PEMFC			SOFC		
		actual	market target	performed	actual	market target	performed
1.	**Cost:**	**17%**	**100%**		**25%**	**100%**	
1.1.	Installed Cost NG, EUR/kW	15000	4000	27%	10000	4000	40%
	Importance: High						
1.2	Operational cost, EUR/kWh	0.3	0.02	7%	0.2	0.02	10%
	Importance: High						
2.	**Durability:**	**49%**	**100%**		**10%**	**100%**	
2.1	Durability in operating conditions, years	2	15	13%	2	15	13%
	Importance: High						
2.2	Cycling ability, number of stops per year	125	125	100%	10	125	8%
	Importance: High						
2.3	Start up time, min	90	15	17%	240	15	6%
	Importance: Moderate						
3.	**Energy Efficiency, %**	**85%**	**100%**		**93%**	**100%**	
3.1	Electrical efficiency, %	28%	35%	80%	30%	35%	86%
3.2	Thermal efficiency, %	59%	65%	91%	55%	50%	100%
3.3	Ratio Electrical power / Thermal Power	0.51	0.04		0.04	0.04	
4.	**Emissions**	**100%**	**100%**		**100%**	**100%**	
	Importance: High						
4.1	Substances, ppm	40					
			CO < 50ppm	100%		CO < 50ppm	100%
	Importance: High		NOx<200 ppm			NOx<200 ppm	
4.2	Noise, dB	0		100%	0		100%
	Importance: High						
5.	**Maintenance interval, h**	1000	8000	13%	2000	8000	25%
	Importance: Moderate						
6.	**Adequacy to user requirements,**	**56%**	**100%**		**79%**	**100%**	
6.1	min. temperature return, °C						
	Importance: High	50	60	83%	500	70	100%
6.2	min. flow temperature, °C						
	Importance: Moderate	70	80	88%	900	90	100%
6.3	size, m	1.5x0.85x1.7	0.5x0.5x1		0.55 x 0.55 x 1.60	0.5x0.5x1	
	Importance: Moderate	2.17	0.25	12%	0.48	0.25	52%
6.4	weight, kg	500	70	14%	170	70	41%
	Importance: Moderate						
	Average for technology:	**39%**	**100%**		**40%**	**100%**	

logistic substitution model

Source: 2011, Forecasting the parameters of the technological dynamics of a technological core area of Chilean mining industry



We fail more often because we solve the wrong problem than because we get the wrong solution to the right problem.

Russell Ackoff

THANK YOU!

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About 20 years of experience for inventive problem solving using OTSM-TRIZ methods as engineer, researcher, consultant, and instructor

1998-2001: professional TRIZ consultant & instructor at LG-Production and Research Centre (LG-PRC, Pyeongtaek, S.Korea);

2001 - 2012 : research engineer, instructor, adviser and consultant for inventive problem solving methods based on OTSM-TRIZ at LGECO, INSA Strasbourg, France.

2003 - : restart of research for method of Reliable Technological Forecasting – Researching Future

- Project_1 (2004 – 2005) Technological forecasting of Fuel Cells for small stationary applications
- Project_2 (2005-2006) Technological forecast of Distributed Generation (DG)
- 4 days course (2008) Vinci, Italy
- 3 days course (2010) Istanbul, Archelik, Turkey
- Project_3 (2011 – 2012) Forecasting the parameters of the technological dynamics of a technological core area of Chilean mining industry (BHP Billiton)
- Project_4 (2013) Express Forecast of technology substitution for beverage packaging, Italy
- Project_5 (2012-) external consultant for FOrecast and Roadmapping for MAnufacturing Technologies (FORMAT) project

2013 - : freelance researcher, consultant, coach, and educator