

ADDITIVE MANUFACTURING REVOLUTION TO REACTION ENGINEERING

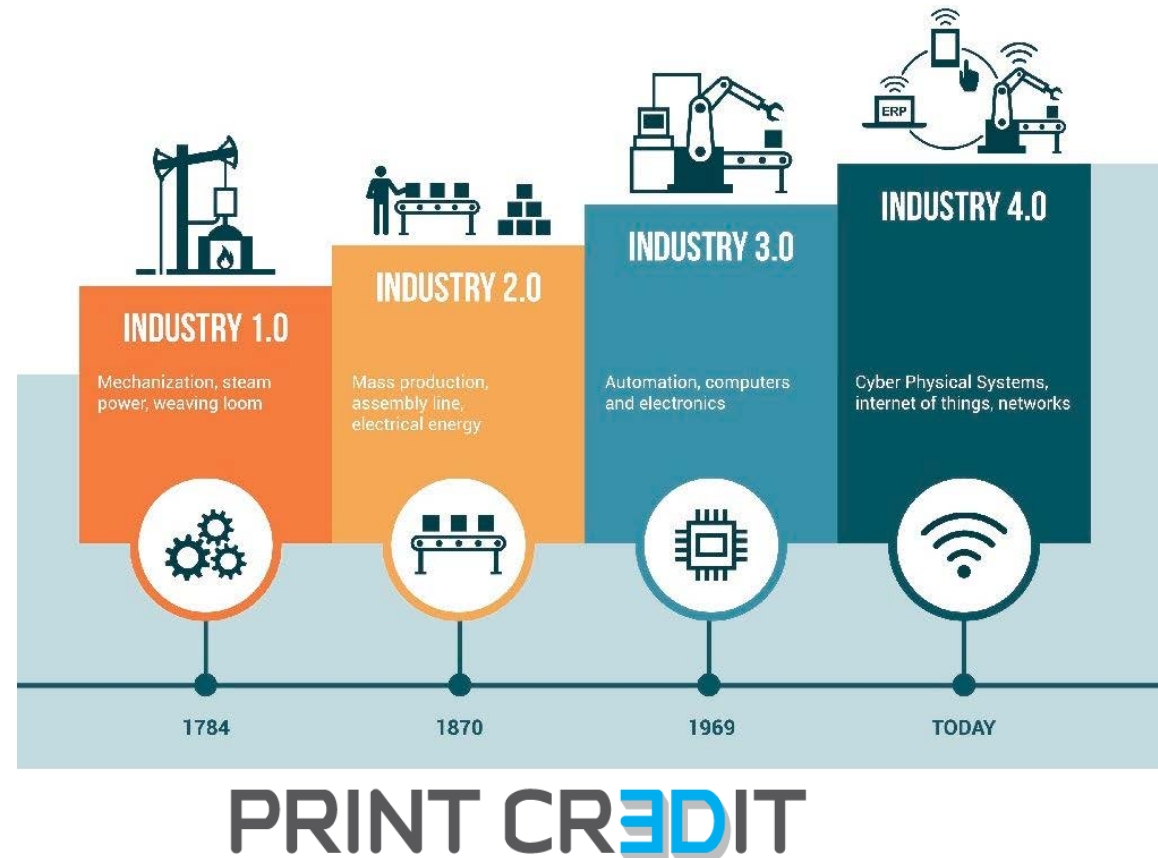
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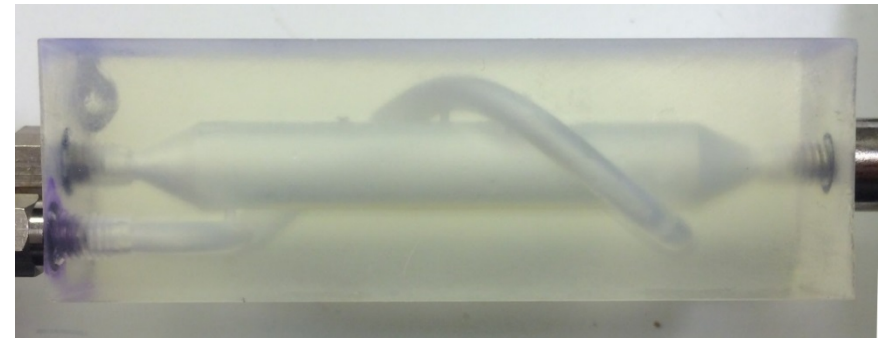
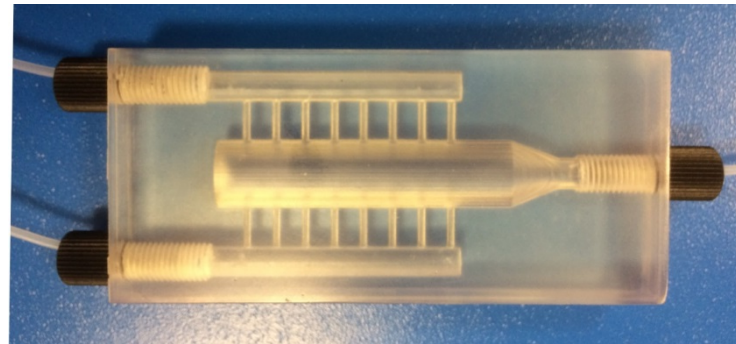
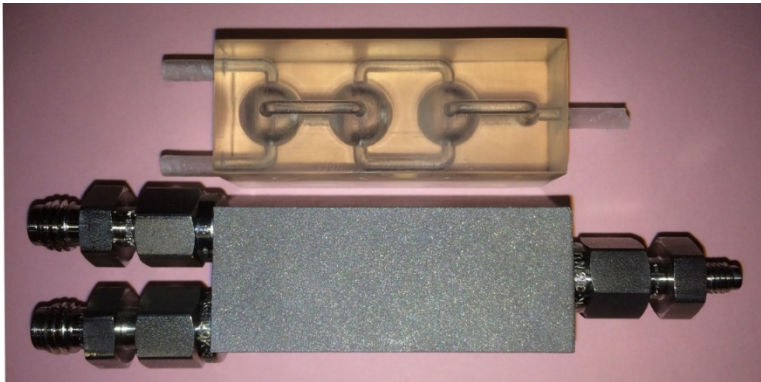
Do we need a change in chemical engineering?

- Historically as a spin-off of mechanical engineering, we may take a look to the possibilities that the fourth industrial revolution can bring to our career.



Additive manufacturing and reactors

- TAILOR THE REACTOR TO THE REACTION.
- Give us freedom of shape.



So how do we do?

- We design a CAD (or equivalent) file.
- We render it to an stl or obj file.
- We send it to print
- We test it for the reaction
- Iterate until a reactor with desired performance is obtained

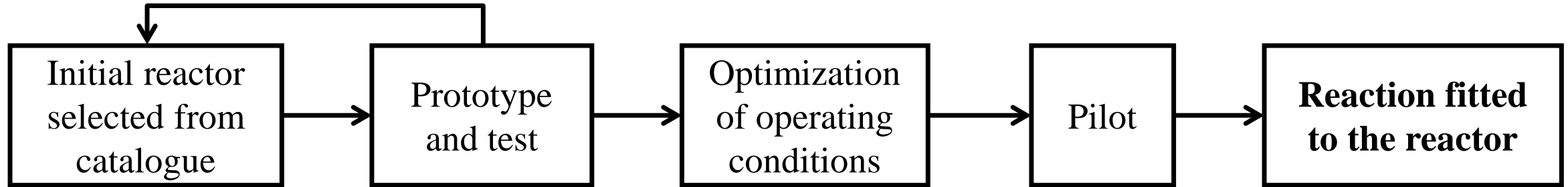
Do we teach
this in ChE?

~~THE RAW WAY!~~
THE WRONG WAY!

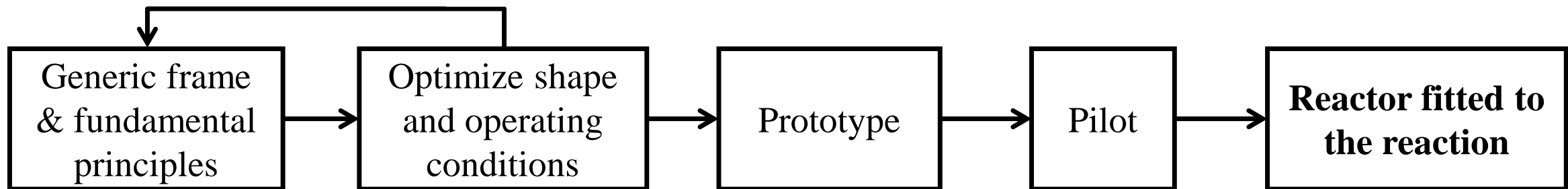
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A better way (perhaps not the optimal)

Current reactor design & optimization



New paradigm in reactor design & optimization



Learning with 3D printed reactors

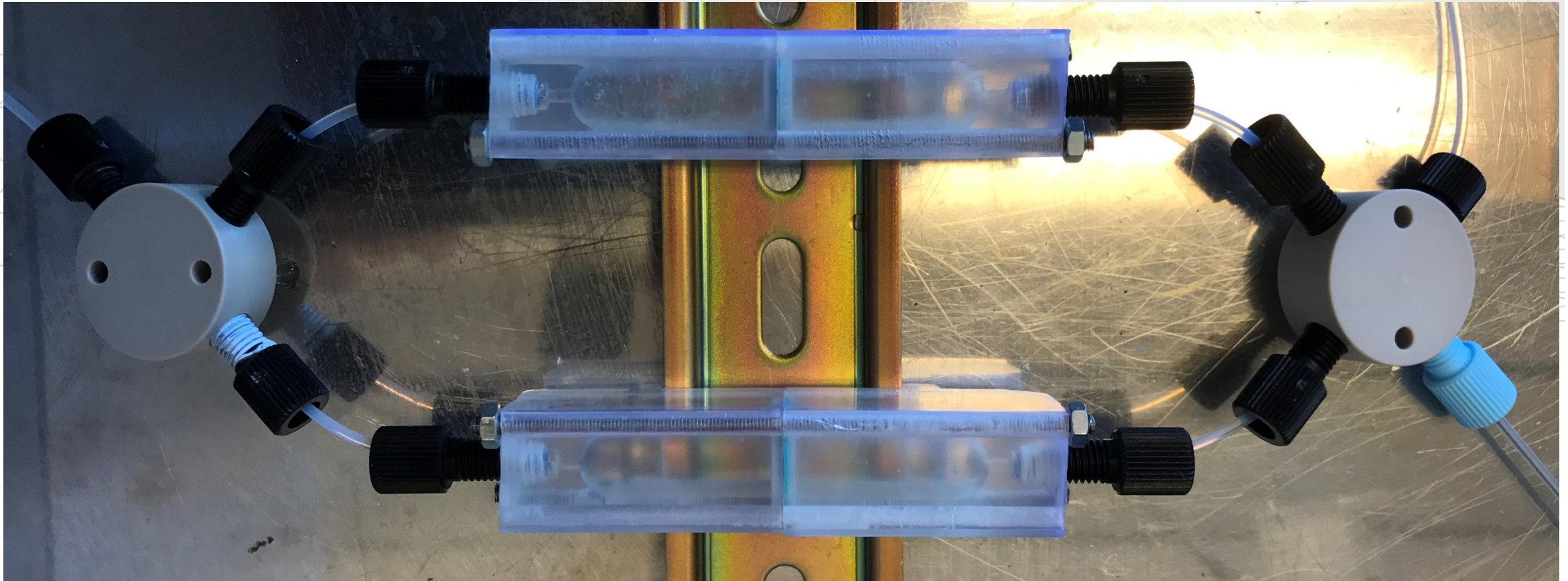
- Learning process that frees the mind.
 - Help us attract brilliant minds to engineering
- Fundamental concepts on reaction engineering are still valid
- The budget can dictate your final quality, but not the learning
 - You can learn to drive with a motorbike and then move to a Ferrari.
- Not only the reactor shape is important but also how to integrate it

Some possibilities

- Initially we have seen in literature Lego[®] types.
 - Difficult to hold on leaks after some experiments
- Lego[®] type but with joints.
 - It was ok but the design gets too complicated because basically everything is 3D printed.
- Our last design is a more standardizable design where only the reactor (and potentially the internals) can be printed while they are connected with standard tubing.

Some pictures

DIN rail dimensions



Conclusions

- 3D printing can be a useful tool to improve energy efficiency of chemical industry.
- Additive manufacturing can be a practical methodology to teach reactor engineering.
 - Different budgets can give same fundamental thinking.
- We have demonstrated one possible method of modular reactors with plug-and-play possibilities.
 - We can print the reactors and the internals also!

Acknowledgments

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Technology for a better society