Migrating a Software Factory to Design Thinking - Paying attention to people and mindsets

Nolwen Mahé, *Design Thinking Montréal*

Bram Adams, *Polytechnique Montréal*

Josianne Marsan and Mathieu Templier, *Université Laval*

Sylvie Bissonnette, *Proaction Technologies/Design Thinking Montréal*

Design Thinking (DT) has found its way into software engineering, promising better requirements elicitation, customer relations, and cohesion within the development team. However, does DT really live up to its promise? This paper reports on the migration of Proaction Technologies towards DT, and empirically evaluates the new DT process through interviews with employees and clients. While DT is able to live up to its promises, its adoption entails paying close attention to the people involved and their mindsets.

Design Thinking (DT) is an approach "that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity" (p. 85)[1]. It combines processes, tools and a mindset taking roots in architecture and product design[2], and is typically used to elicit and prove-in user requirements for the development of new products or services[2]. DT is adopted by many major software providers and promises to become a key success factor by enhancing the customer experience[3,4,5].

Since its adoption has been slow[6,7], research on the application of DT in organizations is scarce. Yet, literature shows that implementing and using innovations can lead to unexpected issues, challenges, and outcomes[8,9,10]. Hence, more studies are needed of real-life DT experiences that offer insights to guide organizations in implementing and using DT[2].

We present an experience report from Proaction Technologies, a company that has transformed its software development factory to integrate DT. Apart from the DT approach taken, we present insights from the trenches regarding prerequisites for success, elements to consider during the process, and expected and unexpected impacts.

Use case context

Proaction Technologies and its flagship product, UTrakk, are presented in Figure 1. The company's DT journey began in early 2018, following the appointment of a new executive vice-president, who had DT experience from previous work settings. At the time, the company was experiencing important issues such as the use of outdated

waterfall-style processes, reduced employee motivation, and communication deficiencies between consultants and developers, in particular in requirement elicitation.

The main motivation for DT was to improve the requirement elicitation processes, to help consultants and analysts identify the most relevant functionalities. This would increase product desirability for the client and increase long-term business viability (better value proposition models).

Another important motivation was to improve the relationship between the clients and Proaction's account managers and consultants. As external stakeholders are closely involved in each stage of DT, they are likely to endorse a partnership role, and increase their trust in the company's products.

Finally, since an expansion of the company size was planned (one-year growth from 5 to 30 developers), executive management anticipated challenges regarding efficient collaboration and knowledge transfer, or potential demotivation. DT was expected to foster team engagement, promote employees' creativity, encourage empathic listening and strong collaboration, and lead to a "fail fast, learn fast" philosophy.

Approach for the DT journey

Figure 1 captures the DT activities carried out over 14 months by Proaction, as well as the deliverables generated by each activity. At least one stage of the full DT process is covered in each activity. The initial cycles allowed Proaction to zoom in on a roadmap, value proposition and business model for UTrakk. Subsequent cycles dug more deeply in each major functionality, with relevant customers.

FIGURE 1. Approach for the DT migration at Proaction.

1. USE CASE CONTEXT

Proaction Technologies

- Software development and consulting company based in Montreal, Canada
- Subsidiary of Proaction International, a consulting company specialized in performance management for individuals and organizations
- Mission is to design and develop technology solutions dedicated to enhancing performance management of organizations
- Provides tailor-made software applications as well as a range of consulting services, such as the configuration and deployment of applications, and coaching for users, managers and executives
- More than 30 employees including developers, product and customer success resources, and vendors
- Over 150 clients in multiple countries, and around 2,000 active users

UTrakk

- Ecosystem of native mobile and web applications that supports managers' activities, communication, and collaboration.
- Multiple functionalities, such as document operational issues, assign problem-solving activities, or track and measure progress in carrying out resolution activities.

2. APPROACH FOR THE DESIGN THINKING JOURNEY[12]

INSPIRATION   **IDEATION**   **IMPLEMENTATION**
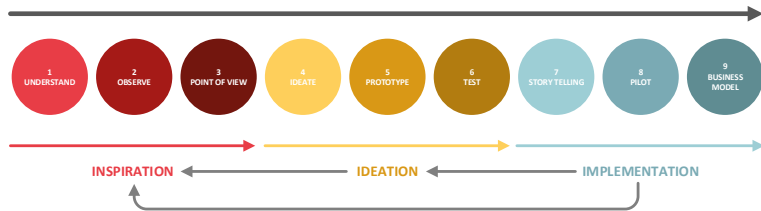
1 UNDERSTAND — Develop an initial contextual knowledge and an empathic understanding of users, of the deeper human side of the problem to solve[13].

2 OBSERVE — Watch, ask questions and reflect on users' behaviors and interactions, as well as physical spaces and places where they evolve[13].

3 POINT OF VIEW — Look at existing solutions to see if they can be reused or combined to create a solution that will have an impact on users' experiences[13, 14].

4 IDEATE — Brainstorm as many ideas as possible, without judgment, to create an innovative solution[13].

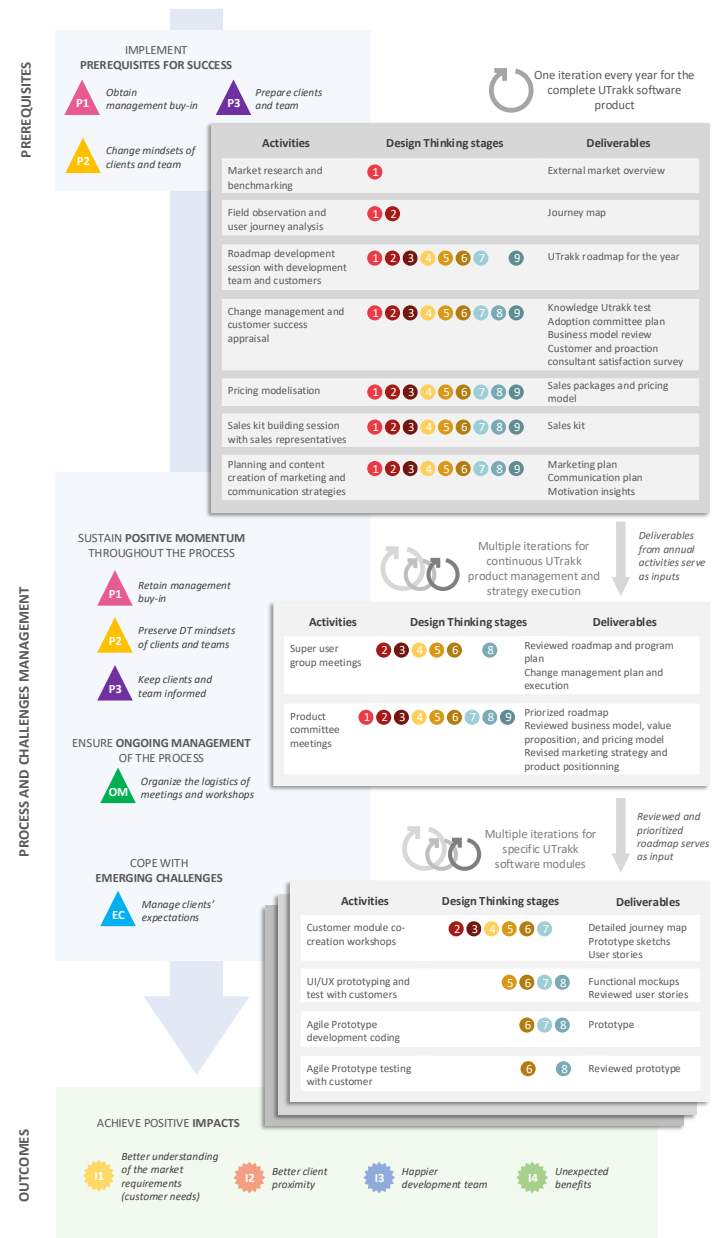**5 PROTOTYPE** — Develop rapidly a rough sketch or model of the solution[13].

6 TEST — Convey the idea of the solution to the users and get their feedback by testing the prototype with them. Based on this feedback, go back to the prototype, modify it if necessary, and retest it[13].

7 STORY TELLING — Develop a concrete, fully conceived plan of action that will motivate the intended audience to carry it forward[15].

8 PILOT — When the solution is almost ready for deployment, test it in real-life context in the form of a pilot deployment[15].

9 BUSINESS MODEL — Adapt the business model and obtain approval to launch the solution[14].

3. INSIGHTS FROM THE TRENCHES

PREREQUISITES

IMPLEMENT PREREQUISITES FOR SUCCESS

- **P1** Obtain management buy-in
- **P2** Change mindsets of clients and team
- **P3** Prepare clients and team

One iteration every year for the complete UTrakk software product

Activities	Design Thinking stages	Deliverables
Market research and benchmarking	1	External market overview
Field observation and user journey analysis	1 2	Journey map
Roadmap development session with development team and customers	1 2 3 4 5 6 7 9	UTrakk roadmap for the year
Change management and customer success appraisal	1 2 3 4 5 6 7 8 9	Knowledge Utrakk test Adoption committee plan Business model review Customer and proaction consultant satisfaction survey
Pricing modelisation	1 2 3 4 5 6 7 8 9	Sales packages and pricing model
Sales kit building session with sales representatives	1 2 3 4 5 6 7 8 9	Sales kit
Planning and content creation of marketing and communication strategies	1 2 3 4 5 6 7 8 9	Marketing plan Communication plan Motivation insights

PROCESS AND CHALLENGES MANAGEMENT

SUSTAIN POSITIVE MOMENTUM THROUGHOUT THE PROCESS

- **P1** Retain management buy-in
- **P2** Preserve DT mindsets of clients and teams
- **P3** Keep clients and team informed

Multiple iterations for continuous UTrakk product management and strategy execution

Deliverables from annual activities serve as inputs

Activities	Design Thinking stages	Deliverables
Super user group meetings	2 3 4 5 6 8	Reviewed roadmap and program plan Change management plan and execution
Product committee meetings	1 2 3 4 5 6 7 8 9	Priorized roadmap Reviewed business model, value proposition, and pricing model Revised marketing strategy and product positionning

ENSURE ONGOING MANAGEMENT OF THE PROCESS

- **OM** Organize the logistics of meetings and workshops

COPE WITH EMERGING CHALLENGES

- **EC** Manage clients' expectations

Multiple iterations for specific UTrakk software modules

Reviewed and prioritized roadmap serves as input

Activities	Design Thinking stages	Deliverables
Customer module co-creation workshops	2 3 4 5 6 7	Detailed journey map Prototype sketches User stories
UI/UX prototyping and test with customers	5 6 7 8	Functional mockups Reviewed user stories
Agile Prototype development coding	6 7 8	Prototype
Agile Prototype testing with customer	6 8	Reviewed prototype

OUTCOMES

ACHIEVE POSITIVE IMPACTS

- **I1** Better understanding of the market requirements (customer needs)
- **I2** Better client proximity
- **I3** Happier development team
- **I4** Unexpected benefits

Insights from the trenches

In order to understand the DT transformation at Proaction, its context and its outcomes, 4 employees and 4 clients of the company were interviewed. The average length of the interviews was 60 minutes. The interviews were then coded in open fashion to find empirical evidence of whether DT does what it was intended to do for Proaction, to identify major impacts of adopting DT as well as prerequisites and other elements for successful adoption in traditional software factories. While she was not involved in interviewing or coding, the input of the last author was also informative, since she is the executive vice-president who initiated the transformation at Proaction.

Our findings show that, while DT is able to live up to its promises, its implementation also requires discernment and cautiousness. Table 1 summarizes the items that a traditional software factory should consider when migrating toward DT. For each item, we provide techniques and guidelines that proved useful at Proaction to avoid pitfalls and increase positive outcomes. Next, we present prerequisites for success of the DT journey, elements to sustain momentum and manage the change process, emerging challenges, and (un)expected impacts of the change.

Table 1. Recommendations of techniques and guidelines to manage prerequisites, meetings and expectations.

	Techniques and Guidelines			
	Inform and communicate	*Involve people*	*Plan and organize*	*Document and keep track*
Prerequisites to develop and sustain				
P1 – Obtain/retain management buy-in	- Provide management champion(s) with strong data on the business impacts of the method, as well as content they can use in their internal communications. - Be transparent on the upcoming events/activities, requirements on the clients' employees, expected morale variation at different steps, and probable needs for support from the champion. - Keep the champion(s) regularly informed, outlining their importance and role.	- Obtain explicit internal champion(s) of the project among the management of each client. - Provide periodic contacts with the company's upper management, reaffirming the importance and seriousness of the project and maintaining the champion's trust. - Provide privileged visibility to the champion(s) to contribute to their personal reputation, both internally and externally.	- Organize the champions as a steering committee, if suitable.	

P2 – Change/preserve mindsets of clients and teams	- Be convinced of your message and show it. - Demonstrate the value of the DT approach. Provide strong data on the scientific bases of the method (as suitable depending on the team's profile), the success stories similar to the problem at hand, and the business impacts of the method. - Adapt the mode of communications to the local culture and team profile. - Make sure the management champion(s) reassure periodically the clients' team about the acceptability of the process.	- Develop trust inside the teams (e.g., by ensuring they know each other personally). Enroll each person in supporting the team's attitude and morale. - Train the internal team on the DT approach (e.g., process and frame of mind). Have them practice with internal challenges (e.g., their own work environment) before exposing them to external clients. - All along the project: train new internal and external team members, similar to the initial teams. Use these trainings as opportunities to reinforce the mindsets of the whole team.		- Provide easy and visible reminders of the expected attitudes, such as brochures or gadget. - Use the tracking of the positive results and outcomes to reinforce the mindsets of the teams. Point out the links between the attitudes displayed and the positive results achieved. Reflect positive changes (including the benefits on the internal functioning of the teams) back to the team members.
P3 – Prepare/keep informed clients and teams	- Be transparent on the upcoming events/activities, requirements on their time, expected morale variation at different steps. - Be graphic, with pictures and videos of real DT workshops. - Be transparent on the downsides of the DT approach, such as the effort and time required on the initial steps. - Put in place a collaboration	- Train the internal team on the DT approach (e.g., process and frame of mind). Have them practice with internal challenges (e.g., their own work environment) before exposing them to external clients. - Use DT workshops (e.g., personas building, journey maps, business model development, etc.) as involvement opportunities for	- Build and share the complete roadmap for the product development, in order to maintain vision and focus during the project execution. - Put in place a ticketing system to facilitate the management and execution of tasks. - Take up a suite of groupware tools (e.g., in the present use case, Aha for the roadmap, Jira for ticketing, Balsamiq	

	platform to facilitate communication and to plan as a team.	internal and external teams. - Engage the internal team in field observation and shadowing of clients for each persona and relevant processes.	sketching for design, zeplin.io to share sketches and mockups, Azure DevOps for task and source code management, Smartsheet for program communication, UTrakk for meeting and action plan, etc.)	
During the course of action				
OM – Organize the logistics of meetings and workshops			- Add external facilitators or attendees in the meetings and workshops (especially the first ones), in order to formalize the DT method and model the expected behaviours. - Select attendees so as to avoid hierarchy pressure. The level of pressure depends on the local business culture and personalities and can be probed through local champions. If necessary, split meetings to reduce the number of hierarchy levels in each.	- Set up an archival method to keep track of all relevant information for the duration of the project and for potential future projects. - Designate a dedicated note taker, who will keep track of the verbal and written exchanges, and also of the ambience and non-verbal interactions. The information produced during meetings is often scattered and tangled. The notes will encode ideas, insights, decisions, so as to make them retrievable in the future.
Emerging challenges				
EC – Manage clients' expectations	- Be clear during the activities about the end to end process, which usually includes further planning steps, e.g.,	- Engage people in person during the production process (e.g., designate privileged points of contacts with periodic	- As the outcomes of the activities go through planning steps inside the company, communicate the new plans	- Describe the archiving systems, to reassure clients about the usefulness of all contributions, even if they

	prioritizing and feasibility assessments.	personal connections) to better assess changes in expectations.	and roadmaps as soon as possible.	are not used immediately.
	- Communicate process results to clients rapidly, outlining their contribution and the priorities decided jointly.			
	- Send progress reports, substantiate decisions and be transparent on potential difficulties.			

Prerequisite 1 (P1): Obtain management buy-in

Just as for any change, strong management backing for DT is essential [Client1/3], especially because the initial steps of DT appear lengthy or ineffective, and, later, because of fluctuations in the morale of the teams involved. This applies both to upper management, who needs to convince its employees to trust the new way of working, as to the client's DT champions. Depending on the latter's personality and DT experience, meetings can range from super-interactive to rather stiff, and their frequency can vary as well. A steering committee can help increase awareness about this, potentially soliciting other people to volunteer as champions.

Prerequisite 2 (P2): Change mindsets of clients and development team

Success does require a certain change in the clients' mindset [Client1/2/3; Employee2/4]: "The client said: "So, I don't buy a software product, I buy a way of working"" [Employee4]. Instead of deciding all by themselves, clients need to be open to validate ideas with other clients (do we really need/want this?) and the development team (is this feasible?).

Success also requires a change in the mindset of the development team [Client3/4; Employee1/4]. Foremost, team members need to become aware and convinced of the need for co-creation, since value can only be obtained by understanding the needs of the client. The humility of listening to the clients and testing one's understanding of a problem must be understood mentally first, then practiced. Further, developers need to become convinced that "The final product will never exist, as long as one continues reflecting and envisioning the future of the product" [Client3], which is a good example of DT's stance that everything is tentative.

Prerequisite 3 (P3): Prepare client and development team for the first DT activities

Due to the unconventional collaborative activities of DT, and the need to change clients' mindset, one major challenge of DT is the need to prepare clients ahead of time for the activities planned for the first encounter, often a full-cycle workshop [Client1/2/3]. Just sending the meeting agenda by email does not suffice, since in the worst case it might not only lead to indifference, but even to negative reactions. It is especially important to clearly explain to management what will be requested from their employees, and even to actively involve management in the organization of DT meetings through the steering committee.

The developers must also be briefed adequately about the DT approach [Employee2/4], since they are technically very knowledgeable and thuseven more likely to dismiss DT activities. Employee2 recommends putting extraeffort during the bootstrap of DT, perhaps involving outsiders in the initial meetings (making them more "official"). Younger team members (e.g., millennials) also have different notions of communication, and management has to be open to them: "one just needs to reach out a hand, one has to pull them towards us, such that they adapt themselves" [Employee4].

Sustain positive momentum throughout the process

It is important to keep up the momentum [Client1/3] created at the outset of the change. While the client has invested in a process rather than a finished product, the end users and other client stakeholders use the product-in-progress to solve their own tasks. At some point, they might be happy with the product, have too limited a view to identify remaining problems or just become tired of the ongoing development: "It is essential to keep on maintaining the motivation, to progress and always go further with this tool" [Client1].

The change in mindset of clients and employees as well as management buy-in must be preserved throughout the process through constant communication with all stakeholders. Also, each new employee must be trained in DT by clearly communicating its purpose and the need to put oneself in the shoes of the client. This is a continuous awareness process, especially since new people only have a limited view of a project.

Ongoing management of the process (OM): Organize the logistics of meetings and workshops

The high degree of interaction during DT meetings means that their logistics need to be well prepared in advance [Client2; Employee3]. For example, one has to be careful with the composition of meetings: "If one meets only with team leads and one or two of their immediate managers, one creates an exchange of ideas, a good dynamic; if one adds two higher hierarchical levels to the meeting, one misses the global effect, since three quarters of the people will shut up" [Client2].

Similarly, it is important to have a dedicated note taker, since the underlying problems identified during an activity often are blurred by the many solutions suggested. One should record not only the spoken words but also the non-verbal behaviour of participants, for example when deciding on priorities for features. Finally, the wealth of information produced on whiteboards, pictures, paper, etc. needs to be carefully archived and indexed to support later follow-ups, if desired.

Emerging challenges (EC): Manage clients' expectations

Once clients become accustomed to DT and fully commit to suggest new features and ideas, it is easy for them and the development team to become discouraged when the "sky is the limit" mindset of DT meets with the limited resources of the organization [Client2/3; Employee2/3/4]. While this is a universal constraint in businesses, DT's focus on thinking about the future makes it easy to raise unrealistic expectations. Client2 noted "The easiest things to put in place have been put in place [...] but we do not have the big elements that we have seen during the meeting", while Client3 stated "One has to address the expectations, or not, one just has to be clear; the upcoming release in the next months will satisfy certain expectations." The time needed for meetings, follow-up and changing the mindset of stakeholders further slows down velocity.

Impact 1 (I1): Better understanding of the market requirements (customer needs)

The interviewed clients and employees agreed that DT has improved requirements elicitation, in the annual roadmap and the lower-level software modules [Client1/3/4]. In particular, Client1 mentioned that, for the first time ever, they had a feeling of being heard and they even felt invested in the evolution of the product. Client3 confirmed that "just that conversation, in which [Proaction] asked [us] what [we] actually needed, showing that [they] cared, that a new release was coming, that has created a nice vibe", while Client4 stated that not only did the product fulfil better the expectations of the client, it was also delivered faster and more intuitive to use.

The key DT ingredient leading to this higher client satisfaction is the focus on feedback-based decision making, both from the client to the development team and within the development team [Client1/2/3; Employee4]. Clients installed their own mechanisms to solicit and manage feedback from their local user base, in the form of prototypes (even just slideware), videoconferences, or a custom knowledge base of opportunities for improvement of the product. This amassed feedback could then be fed back to Proaction. Internally, DT also sparked more feedback between the employees, pushing themselves to identify inhibitors and opportunities for improvement in the product and in the development process.

Impact 2 (I2): Better client proximity

Clients and employees again confirmed that DT has led to a more intense client interaction [Client1/3; Employee2/3], as already hinted at by the feedback-based decision making. In contrast to traditional, agenda-driven meetings, DT meetings stress interaction between people and induce one to take a step back and think about one's actual needs for a product. Especially powerful were the workshops in which multiple clients participated, since these allow clients to put their own needs into perspective, and even to provide advice to each other. While successful client interactions require a change in mindset, the threshold to participate is low, typically just an initial ice breaking activity. Throughout the many events involving clients, a personal connection is built that benefits later activities with clients, such as product support.

Impact 3 (I3): Happier development team

DT has also led to a tighter-knit development team [Client3; Employee1/2/3/4]. People talk more to each other, have fun together (even outside of work), are proactive and motivated. The team works together in synergy without forgetting the personal growth of each member. As such, each member feels implicated, can observe where the team is heading and fully supports Proaction Technologies' focus on improving product quality.

Impact 4 (I4): Unexpected benefits

The change in mindset of clients and employees has brought a number of unexpected benefits. First, a feeling of ownership/entitlement about the improved quality of the product: "It's because I was there, I talked about my needs" [Employee4], which in turn leads to bigger investments of a client company into the product, with larger roll-outs. Second, the DT way of collaboration inspires clients to spice up their other projects with activities like mini-games

or role-playing games, in order to engage meeting participants and deepen the understanding of each other's needs. Even the operators of the deployed products started to adopt DT ideas to streamline their work [Client1]. Third, the members of the development team have a stronger belief in what they are doing, and, for example, are more willing to volunteer for tasks involving clients. Fourth, the acquired DT skills also will more likely become a second nature for the members of the development team, readily applicable in other contexts: focusing on value and refining questions to better understand the problem, for example.

Conclusion

The mix of tools and human interactions that qualify DT as a Social Technology has demonstrated business advantages[11]. This paper provides an experience report of Proaction Technologies' migration towards DT, pointing out positive results such as substantially increased client and development team satisfaction. In the process, a number of practical insights were identified that should be considered by other companies contemplating a migration to DT, especially the early tackling of changes in the mindset of the clients and the development team. Future work should shed light on the interaction between DT and other modern software engineering practices, such as agile and DevOps. Furthermore, a deeper analysis is needed of the correlation between DT and objective measures of software quality or cost effectiveness.

References

1. T. Brown, "Design Thinking," *Harvard Business Review*, vol. 86, no. 6, pp. 84-95, 2008.

2. F. Engberts and H.P. Borgman, "Application of Design Thinking for Service Innovation: Current Practices, Expectations and Adoption Barriers," *Hawaii International Conference on System Sciences*, pp. 1611-1620, 2018.

3. G. Phifer, "Design Thinking Can Revolutionize Your Customer Experience Strategies," *Gartner Group*, 2018.

4. M. Gruber, N. De Leon, G. George, and P. Thompson, "Managing by design," *Academy of Management Journal*, vol. 58, no. 1, pp. 1-7, 2015.

5. J. Kolko, "Design thinking comes of age," *Harvard Business Review*, vol. 93, no. 9, pp. 66-71, 2015.

6. J. Liedtka, "Perspective: linking design thinking with innovation outcomes through cognitive bias reduction," *Journal of Product Innovation Management*, vol. 32, no. 6, pp. 925-938, 2015.

7. K. Dorst, "The core of 'design thinking' and its application," *Design Studies*, vol. 32, no. 6, pp. 521-530, 2011.

8. J.N. Choi and W.J. Moon, "Multiple forms of innovation implementation: The role of innovation, individuals, and the implementation context," *Organizational Dynamics*, vol. 42, no. 4, pp. 290-297, 2013.

9. E.P. Piening, "Insights into the process dynamics of innovation implementation," *Public Management Review*, vol. 13, no. 1, pp. 127-157, 2011.

10. G.H. Chung and J.N. Choi, "Innovation Implementation as a Dynamic Equilibrium: Emergent Processes and Divergent Outcomes," *Group & Organization Management*, vol. 43, no. 6, pp. 999–1036, 2018.

11. J. Liedtka, "Why Design Thinking Works," *Harvard Business Review*, https://hbr.org/2018/09/why-design-thinking-works. September-October, 2018.

12. R. Dam and T. Siang, "Design Thinking: A Quick Overview," *Interaction Design Foundation*, https://www.interaction-design.org/literature/article/design-thinking-a-quick-overview. 2019.

13. J. Ratcliffe, "Steps in a Design Thinking Process", *The K12 Lab Wiki of Stanford Design School*, https://dschool-old.stanford.edu/groups/k12/wiki/17cff/Steps_in_a_Design_Thinking_Process.html. 2009.

14. École des ponts, "Our d.school process," http://www.dschool.fr/en/design-thinking/. 2019.

15. C. Rajesh, "Change by Design: Tim Brown," https://medium.com/agileconnexions/change-by-design-tim-brown-2ed3271f6f19. 2016.

Nolwen Mahé (engineering degree, M.B.A., PMP) is co-founder of Design Thinking Montréal, a collective of training and implementation professionals. Contact her at nmahe@hotmail.com.

Bram Adams (PhD, Ghent University) is Associate professor in software engineering at Polytechnique Montreal (Canada). He is head of the Lab on Maintenance, Construction and Intelligence of Software, and a principal investigator in the SECOHealth project. Contact him at bram.adams@polymtl.ca.

Josianne Marsan (PhD, HEC Montréal) is Professor in Information Systems (IS) at Université Laval (Canada). She is head of the Research Center on Information Technology and Business (CeRTIA), co-investigator in SECOHealth and member of the Governance Board of the CHAOSS project. Contact her at josianne.marsan@sio.ulaval.ca.

Mathieu Templier (PhD, HEC Montréal) is Associate professor in IS at Université Laval. He is a member of CeRTIA and collaborator in SECOHealth. Contact him at mathieu.templier@sio.ulaval.ca.

Sylvie Bissonnette (B.Sc.A., Université du Québec en Outaouais) is Executive Vice-President, Information Technologies, and CIO, Proaction Technologies, a division of Proaction International. She is also co-founder of Design Thinking Montréal. Contact her at SBissonnette@proactioninternational.com.