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CORE THEMES OF DESIGN THINKING IN MONO- AND MULTILINGUAL TEAMS. RESEARCH BASED ON THE SYSTEM OF ORGANIZATIONAL TERMS

Olaf Flak[1]

Abstract

The concept of Design Thinking has emerged as a consequence of a human-centred approach to innovation. It can be used not only to create new products and services but also to solve organizational and business problems focused on man and his problems. It is said that Design Thinking is becoming more a culture attribute than a specialized expertise. Its elements – user focus, problem framing, problem visualization, experimentation and diversity – strongly depend on a culture and a language that dominates in a team. The first aim of this paper is to verify two hypotheses. Firstly, multilingual teams use more elements of Design Thinking to solve the problem than monolingual teams. Secondly, multilingual teams are more diversified in using elements of Design Thinking than monolingual teams. The second aim of this paper is to present the high potential and ability of the system of organizational terms as a methodological concept in the research of teamwork in an organization. The methodology used in the study was a non-participating, long-term observation of 3 monolingual and 4 multilingual teams. Their work was recorded by 10 online management tools called TransistorsHead built on the foundation of the system of organizational terms.

Keywords: *Design Thinking, system of organizational terms, management tools, culture.*

1. Introduction

The concept of Design Thinking has emerged as a consequence of a human-centred approach to innovation. It was based on the assumption that the effects of work derive from the ways that people think and work (Brown, 2008).

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Design Thinking is a process focused on a man and his problems. It can be used not only to create new products and services but also to solve organizational and business problems (Lockwood, 2009). This approach includes a deep belief that it is more efficient to give design tools to people who have never been engaged in the design process than to keep to the traditional division of labor. These tools also help practical problems in many areas of running a company (Brown, 2009, p. 4).

It is said that Design Thinking is becoming more a culture attribute than a specialized expertise (Ben Mahmoud-Jouini, Midler & Silberzahn, 2016, p. 150). Recent developments in Design Thinking claim that it needs to move to the attributes of the culture which dominate in a company and where strategic decisions are made (Brown, 2009). In the area of culture, most kinds of tacit knowledge are created in a language and it is not typically associated with intentionality and deliberation. Explicit, procedural knowledge develops incrementally over time and it comes from a group or an organization's norms, origin and routines also expressed in a language which dominate in such a group (Erden, Krogh, & Nonaka, 2008).

The way of using Design Thinking as a work methodology depends on the cultural diversity of the team, with one of the elements being the native language of members. It is even more important than the number of members or team member competences, and it can influence the complexity of collaboration positively or negatively (Zhang, Lowry, Zhou, & Fu, 2008). What is more, in relation to Design Thinking, past research shows that multiculturalism in teams has distinct, positive effects on this process (Martins & Shalley, 2011). Therefore, the following research problem can be stated in a general research question: does the native language of a team influence the level of Design Thinking elements used to solve problems?

According to this research problem, there are two hypotheses posed by the author:

H1. Multilingual teams use more elements of Design Thinking to solve the problem than monolingual teams.

H2. Multilingual teams are more diversified in using elements of Design Thinking than monolingual teams.

The first aim of this paper is to verify the hypotheses based on the observation of 35 team members coming from different countries and different cultures. The second aim of this paper is to present the high potential and ability of the system of organizational terms as a methodological concept in the research of teamwork in an organization. The methodology used in the research was a non-

participating, long-term observation of 3 monolingual and 4 multilingual teams which were given the task of preparing a training program for teachers and administrative staff at Haaga-Helia University of Applied Science in Helsinki. Their work was recorded by 10 online management tools called TransistorsHead built on the foundation of the system of organizational terms.

2. Literature background

2.1. Design thinking

Design Thinking is defined as a method of work, which uses common sense and designers' techniques in order to meet peoples' needs, by technological abilities supported by a reasonable business strategy. The effect of Design Thinking has to be a real value for consumers (Brown, 2008, p. 86). It is also called "integrative thinking" which is a way of thinking that combines the generation of new ideas (abductive logic) with their analysis and evaluation of how they are applied (deductive, inductive logic) (Dunne & Martin, 2006, p. 518). The interest for the idea of Design Thinking comes from the fact that it improves the process of creating and implementing solutions as a multidisciplinary, human-centred innovation approach inspired by designers (see more in Johansson-Sköldberg, Woodilla, & Ceinkaya, 2013, p. 40).

Design Thinking can be described as a team based, user-centred process, powered by a thorough understanding of what users want and need. It is not only used for projecting technical or product innovations, but also for finding solutions to undefined organizational or social problems (Dijksterhuis & Silvius, 2017). The core of design practice lies in the ability of designers to frame and reframe a given problem, thereby creating a novel standpoint from which a problematic situation can be tackled. Design Thinking is also treated as a concept used in managing projects that combines the needs and desires of people with technological abilities implemented in a business strategy (Gawroński & Seredocha, 2012).

Design Thinking is strongly connected to exploration and learning (Beckman & Barry, 2007). This is a process which can be described as a set of activities mixed with one another and done one after another with many loops and repetitions (Cooper, Junginger, & Lockwood, 2009). This implies that the work includes ambiguity, unknown parameters, and a long route to the expected results (see more in Rauth, Carlgren, & Elmquist, 2014, p. 48).

It emphasizes an observation to understand people, leading to empathy, insights and analysis. This observation involves a wide search for information, visualization, perspectives and insights into a problem by experiment. It

engages empathy and intuition to discover new patterns and themes (Glen, Suciu, Baughn, & Anson, 2015).

There are 5 core themes which describe Design Thinking in practice (Carlgren, Rauth, & Elmquist, 2016):

- collaboration - users try to understand needs through research and a qualitative approach, they are influencing each other, and they are focused on collaboration more than following the instructions of a manager;
- problem framing - team members are expanding problems and a space of solutions, they create new ideas during brainstorms and specify ideas in details;
- problem visualization - team members visualize ideas and make them tangible, they practice "thinking by doing," they try to describe problems and create choices;
- experimentation - they quickly prototype and test solutions creating different options of solving problems, they perceive failures positively with playfulness and humor;
- diversity – a team is diverse inside which is treated as a strength of the team, members do many different activities on the way to solutions, these activities are mixed and they are taken one after another in many different combinations.

As was listed above, the first theme is collaboration. Collaboration means an emphasis on co-operation and communication with colleagues, partners and customers. It needs interaction between team members and an open attitude of a manager in delegating tasks and giving members of a team as much freedom as they can have (Brown & Martin, 2015). The second theme is problem framing. It emphasizes observation for the purpose of understanding people, leading to empathy, insights and analysis. Using many managerial techniques, such as brainstorms, 5 why and other creative techniques, the problem has to be translated into understandable frames and terms (Glen et al., 2015). The third theme is problem visualization. On the one hand, physical objects can be used, which increase the level of understanding intangible issues, such as customers' experiences and service. A team tends to use physical models, diagrams and sketches that give additional dimensions to the exploration of problems (Kolko, 2015).

The fourth theme is experimentation, which is an iterative prototyping. It allows early engagement with customers or users of the solutions, along with very low-resolution prototyping cycles of iterations and getting feedback from the users (Brown & Martin 2015). The fifth theme is diversity, which refers to collaboration in diverse teams, and the integration of different activities within the process (see more in Carlgren et al., 2014, p. 48).

The differences in a rational analytic approach used in solving problems compared to Design Thinking are shown in Table 1.

Table 1. Comparison between rational analytic and design thinking

Criteria	Rational analytic	Design thinking
Problem formulation	Well-defined goal and constraints.	Goals and constraints uncovered during the design-thinking process.
Criteria	Objectives definition	Both objective and subjective criteria used to define objectives, since the end user is the ultimate judge of efficacy.
Method	Planning and analysis. Sequential process.	Iterative exploration of the design "space," where thinking is repetitive.
Information-processing emphasis	Preference for objective formulations, especially verbal and quantitative.	Preferences for visual and spatial representations, which evoke both objective and subjective insights.
Solution process	Ideally based on conscious, rational-logical reasoning process, which, over time, becomes formalized into a set of rules.	Solutions evolve as the result of interaction with users and ongoing creation and refinement of possible solutions. Incorporates experience-based insights, judgment and intuition.
Rationale	"Get it right." Reduce chances of failure though careful prior analysis.	Use rapid experimentation and prototyping to learn from early, inexpensive "failures."
Outcome	Solution optimizes predefined criteria to arrive at "best" answer.	Obtain "better" answer. Process may expose additional problems and solutions.

Source: Glem, Suciu & Baughn (2014, p. 662).

2.2. Cultural foundations of design thinking

A culture is a complex of knowledge, beliefs, art, morals and laws, customs and other habits shared by man as a member of a certain society (see more in Murphy, 1986, p. 14). This meaning, which is widely used in the humanities, is designed for describing a system of subjects, behaviors and processes and those activities and symbols that were made because of human acts (see more in Cameron & Quinn, 2006, pp. 16-17). Another version of a culture's definition introduced a division of culture which consists of three groups of items (Shein, 2004):

- visible aspects that need to be interpreted (a system of symbols, languages, rituals, relationships among the first group);
- partly visible elements and non-visible (norms and standards, ideologies, acceptable behaviours and manners);
- unconscious elements (relationship between man and environment, perception of the truth, human nature, basic human activities, needs and interpersonal relations).

It is said that the core themes of Design Thinking – user focus, problem framing, problem visualization, experimentation and diversity – strongly depends on a culture which dominates in a team (see more in Kolko, 2015, p. 68). That is why the core of any culture is constructed on a value system which contributes substantially to its normative traits. Additionally, value orientation, along with cultural cognition, is one of the most important components that can underpin a theory of design (see more in Fitzgerald, 2003, p. 52). A culture generalizes perception or assumptions expressed in a language. The language forms the actions are taken in Design Thinking. These actions are appropriate within some socially constructed system of norms, values, beliefs, and definitions (see more in Suchman, 1995, p. 574). Cultural elements of Design Thinking, such as the focus on experimentation and iterations, are based on a different logic which depends on team culture (Lester Piore, 2004). It is also seen at the operational level of Design Thinking. The dominating language of the culture also influences the techniques and tools used by a leader and his team to solve problems or create ideas (see more in Gasparini & Chasanidou, 2016, p. 7).

The differences in elements of a culture, such as a mutual and native language, strongly address communication differences in teamwork. Many projects, in which Design Thinking is used, are characterized by the great difficulty of quantifying uncertainty, management flexibility and tolerance of vagueness (Atkinson, Crawford, & Ward, 2006). Therefore, it is said that a cultural approach enriches a design theory and underpins cultural aspects of design practice (see more in Fitzgerald, 2003, p. 50).

In the literature, it is claimed that the ambiguous nature of Design Thinking is often in conflict with dominant approaches to organizational cultures. It also implies the view that any concept should be interpreted as the effect of culture and not as an independent way of thinking (see more in Carlgren, Rauth, & Elmquist, 2016, p. 346). The cognition of the world and the way of thinking are inevitably dependent on a language which may become dominant in a certain period of time (see more in Fitzgerald, 2003, p. 53).

Therefore, there is a need to explore the regularities in cultural influence that use elements of Design Thinking in managing projects and solving problems. In this paper, there is an attempt at verifying two hypotheses concerning the influence a type of a culture (represented by mono- versus

multilingual teams) has on a way elements of Design Thinking methodology are used in teamwork. It needs to be emphasized that the conclusions of the research concern only the group of participants and they cannot be interpreted as valid for any other teams or organizations.

3. Research approach and methods

Participants of the study were BA business students from Haaga Helia University of Applied Sciences in Helsinki. It was carried out from 26th of September to 20th of December 2017 in Finland. Participants were divided into 7 teams, each of which consisted of five members and were created purposefully. Three teams were homogenous in terms of a culture and a language (Finnish, American and French teams). For the validity of the research, the participants' place of birth was also checked and 86% of them (13 out of 15 participants belonging to these teams) were found to be born in the countries which were used as teams' nationalities in the observation. Four other teams were heterogeneous both culturally and linguistically and their common working language was English.

The teams were given the task of preparing a training program for teachers and administrative staff at Haaga-Helia University of Applied Science in Helsinki within the GloBBA degree programme, during both planning and implementing semester modules. The expected result of the participants' work was a report, which had to contain two parts: training programme details (participants, number of participants, venue, duration, name of the training programme, goals of the training programme, benefits for the participants, training methods, detailed parts of the training programme) and teamwork process (individual reflections on the work process, possible difficulties, the positive aspects, etc.).

In order to perform the task, participants were given online managerial tools, available from Transistorshead.com. There are 10 online managerial tools for setting goals, describing tasks, generating ideas, specifying ideas, creating options, choosing options, checking motivation, solving conflicts, preparing meetings, and explaining problems. The online management tools were designed and implemented on the basis of a methodological concept called the system of organization terms. They were also used as research tools and they recorded the activities and the qualitative and quantitative aspects of teamwork during the study. The participants were trained to use the online management tools and they were trained on the rules of Design Thinking in order to have some theoretical and practical background to perform the task.

The theoretical background for this research approach is the system of organizational terms that is an original methodological concept of organizational

research (Flak, 2013). The philosophical foundation of the system of organizational terms is based on Wittgenstein's theory of facts (the only beings in the world) and "states of facts" (Brink & Rewitzky, 2002). This theory was developed by the author in two types of beings in the world: events and things. They are combined with one another in the way that is shown in Figure 1.

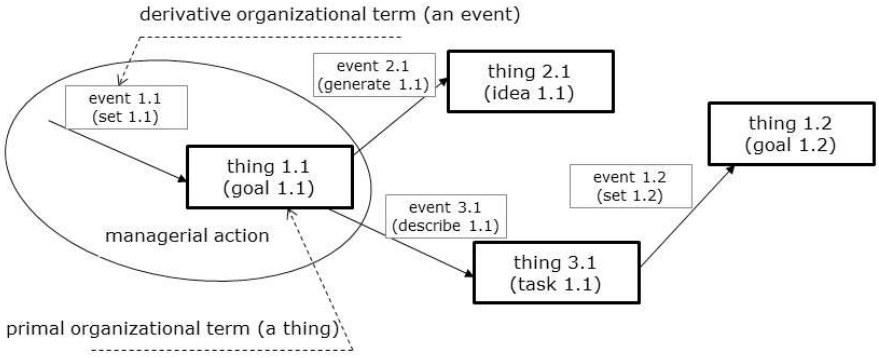

Figure 1. Fundamental structure of the organizational reality

As is shown in Figure 1, when a manager sets a goal, he creates *an event 1.1* (*set 1.1*) which results in *a thing 1.1* (*goal 1.1*). In the system of organizational terms, they are called derivative organizational term and primal organizational term, respectively. This pair creates a unit called a managerial action (Yang, Flak, & Grzegorzek, 2018).

Specifically, as shown in Figure 1, events and things have the label *n.m*, in which *n* and *m* represent a number and a version of a thing, respectively. If later (after the next managerial action – *describe 1.1* and *task 1.1*) this manager does the next setting of the same goal (*set 1.2*), he launches the next managerial action and *goal 1.1* changes into *goal 1.2*. *Goal 1.2* represents the second version of this managerial action (described by the pair of the event and the thing: *set 1.2* and *goal 1.2*). The differences between the features of *goal 1.2* and *goal 1.1* determine the reasoning for the event *set 1.2* which happened after a certain period of time. After recording managerial actions in such a way it is possible to build a model of what this manager really did. It is necessary to say that team members also act the same way and their activities can be modeled this way.

As was mentioned above, the research tools were the online management tools recording managerial actions done by team managers and team members. From a theoretical point of view, online management tools have two features. Firstly, every online management tool tracks and records one

specific managerial action according to the idea of a "unit of behavior" (Curtis et al., 1992). Secondly, using any online management tool is equal to an event which results in a thing – see Figure 1 (Flak, 2013).

The online management tools used in the study are available at TransistorsHead.com whose dashboard is shown in Figure 2. Gathered data is divided into two parts: (1) a time domain and (2) a content domain. In the time domain (1) all button clicks are recorded in the function of time. Therefore, it is possible to conclude what a manager did with a second time rate (alike in making a movie). In the content domain (2) all data is saved and it is never deleted. That is why it is possible to analyze the way of cognitive processes during managerial actions (Alnajjar & Flak, 2016).

From the data analysis point of view, it is important to point out 3 universal actions of every online management tool. Firstly, there is a function called ADD which lets a manager create an item in every tool (e.g., a goal in a tool called *set goals*). The ADD action is only available to managers and not to team members. Secondly, both managers and team members can EDIT the item (e.g., a goal) which was created before. The confirmation of this action is a SAVE button. Thirdly, both managers and team members can use VIEW action to see the previous results of work.

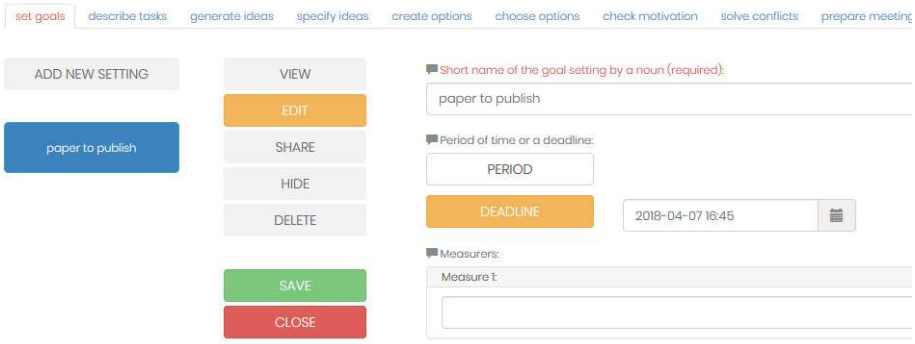

Figure 2. Dashboard of TransistorsHead with online management tools

4. Discussion and results

In order to verify the hypotheses shown in Section 1, the complex index of Design Thinking was designed. For the purpose of this paper, it was called *DT index*. The assumption was that we could measure the scale of work which was done according to Design Thinking methodology.

The scale of the *DT index* is from 0 (no work in Design Thinking methodology) to 100 (all work is done according to Design Thinking rules). The *DT index* consists of 5 elements which correspond to the 5 core themes which describe Design Thinking in practice: collaboration, problem framing, problem visualization, experimentation, and diversity. Every core theme also has its own measure on the same scale as *DT index*: from 0 (no work in Design Thinking methodology) to 100 (all work done according to Design Thinking rules). Therefore, the *DT index* can be calculated as an average of all the element measures.

Table 2. Description of team collaboration

		No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
		Group name	Les Baguettes	Mean Girls	The Sailors	De Badeendjes	All Gucci	Vindicators	East meets West
		Group type	monolingual	monolingual	monolingual	multilingual	multilingual	multilingual	multilingual
		Nationality	French	American	Finnish	International	International	International	International
Type of users	**Type of actions**	**Symbol**							
leader actions	ADD	A1	66	64	52	71	19	30	49
	EDIT	E1	69	57	58	121	19	48	48
	SAVE	S1	182	119	175	197	45	83	106
	SAVE-ADD	S1-A1	116	55	123	126	26	53	57
members action	VIEW	V1	18	51	16	68	5	28	11
	EDIT	E2	191	136	101	272	49	47	102
	SAVE	S2	142	93	57	241	32	18	107
	VIEW	V2	84	208	144	205	39	46	128
		Function							
parameter	S	S2/(S1--A1+S2)	55,04	62,84	31,67	65,67	55,17	25,35	65,24
	V	V2/(V1+V2)	82,35	80,31	90,00	75,09	88,64	62,16	92,09
	A ratio	S/(S+V)	40	44	26	47	38	29	41

The first core theme of Design Thinking concerns collaboration. This parameter is represented by the *A ratio* in Table 2 and it shows relations of active (EDIT+SAVE) and passive (VIEW) interactions between a leader and team members. It can be treated as a level of participation of team members in team activities, including the leader. This parameter was calculated in 4 steps:

1) Establishing the numbers of actions in online management tools (ADD, EDIT, SAVE, SAVE-EDIT, VIEW in Table 2 given for every team in a division of a leader and members).

2) Calculating te *S* parameter which means a relation of active actions taken by team members to all active actions taken by a leader and team members (multiplied by 100).
3) Calculating the *V* parameter which means a relation of passive actions taken by team members to all passive actions taken by a leader and team members (multiplied by 100).
4) Calculating the *A ratio* as a relation of the *S* parameter to a sum of the *S* and *V* parameters.

As is shown in Table 2, the highest level of collaboration was characterized by the multilingual group 4. Nevertheless, another two highly collaborative groups were the monolingual - 1 (American) and 3 (French). What is interesting is that the lowest collaborative group was also a monolingual group 3 (Finnish).

The second core theme of Design Thinking – problem framing – is represented by a parameter called *B ratio*. It shows the level of framing problems compared to the number of defined problems. Participants were given two online management tools which were created to describe problems with some parameters. The tools are called *generate ideas* and *specify ideas*. Some problems can be tackled and drafted, but they are never fully framed. That is why there are 4 steps in order to calculate the *B ratio*. They are as follows:

1) Establishing the numbers of actions in *generate ideas* and *specify ideas* tools (ADD, EDIT, SAVE in Table 3 given for every team in a division of both tools).
2) Calculating the *B1* parameter which means a relation of framed problems (SAVE) by a leader and team members to all problems (ADD, EDIT, SAVE) tackled by a leader and team members (multiplied by 100) in the *generate ideas* tool.
3) Calculating the *B2* parameter which means a relation of framed problems (SAVE) by a leader and team members to all problems (ADD, EDIT, SAVE) tackled by a leader and team members (multiplied by 100) in the *specify ideas* tool.
4) Calculating the *B ratio* as an average of the *B1* and *B2* parameters.

As is shown in Table 3, the highest level of problem framing belongs to multilingual groups 7 and 4. However, another two multilingual groups - 5 and 6 - were at the bottom of the ranking. All monolingual teams (1, 2 and 3) had nearly equal levels of problem framing which was in the middle of the scale.

The third core theme of Design Thinking is represented by the *C ratio* and it concerns problem visualization. In TransistorsHead there are two tools which can be used in order to present a problem. However, they are not graphic applications. There are *create options* and *explain problems* tools. Similarly, as in the *B ratio,* not all problems which were started to be modeled were fully described. That is why the procedure of calculating the *C ratio* is similar to a *B ratio* procedure.

Table 3. Description of problem framing

		No.	1	2	3	4	5	6	7
		Group name	Les Baguettes	Mean Girls	The Sailors	De Badeendjes	All Gucci	Vindicators	East meets West
		Group type	monolingual	monolingual	monolingual	multilingual	multilingual	multilingual	multilingual
		Nationality	French	American	Finnish	International	International	International	International
Type of tools	**Type of actions**	**Symbol**							
generate ideas	ADD	A	3	8	4	7	1	12	4
	EDIT	E	71	112	66	224	46	49	49
	SAVE	S	37	77	42	169	27	54	54
specify ideas	ADD	A	1	1	3	7	1	2	1
	EDIT	E	3	7	19	11	0	0	2
	SAVE	S	6	10	20	31	0	0	7
		Function							
parameter	B1	S/(A+E+S)	33,33	39,09	37,50	42,25	36,49	46,96	50,47
	B2	S/(A+E+S)	60,00	55,56	47,62	63,27	0,00	0,00	70,00
	B ratio	(B1+B2)/2	47	47	43	53	18	23	60

The only change concerns the tools used to gather data about this process. There are 4 steps:

1) Establishing the numbers of actions in *create options* and *explain problems* tools (ADD, EDIT, SAVE in Table 4 given for every team in a division of both tools).
2) Calculating the *C1* parameter which means a relation of modeled problems (SAVE) by a leader and team members to all problems (ADD, EDIT, SAVE) tackled by a leader and team members (multiplied by 100) in the *create options* tool.
3) Calculating the *C2* parameter which means a relation of modeled problems (SAVE) by a leader and team members to all problems (ADD, EDIT, SAVE) tackled by a leader and team members (multiplied by 100) in the *explain problems* tool.
4) Calculating the *C ratio* as an average of the *C1* and *C2* parameters.

Table 4 shows that the highest level of problem visualization concerns a monolingual group 3 (Finnish). The second position in this ranking belongs to the second monolingual group 1 which came from France. The rest of the groups, no matter whether they were multilingual (American) or monolingual teams, had a very low level of problem visualization, and one of multilingual teams (team 5) did not model problems at all.

The fourth core theme is experimentation. In the study, it was possible to estimate the parameter of experimentation for every group, because the online management tools which the participants were given, recorded their activities during all observation periods (when they were logged to TransistorsHead). Therefore, any changes of created items were saved to the database.

Table 4. Description of problem visualisation

		No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
		Group name	Les Baguettes	Mean Girls	The Sailors	De Badeendjes	All Gucci	Vindicators	East meets West
		Group type	monolingual	monolingual	monolingual	multilingual	multilingual	multilingual	multilingual
		Nationality	French	American	Finnish	International	International	International	International
Type of tools	**Type of actions**	**Symbol**							
create options	ADD	A	1	6	3	2	1	0	11
	EDIT	E	0	10	0	1	0	0	48
	SAVE	S	1	16	7	4	0	0	46
explain problems	ADD	A	3	2	4	0	0	2	0
	EDIT	E	1	0	3	0	0	1	0
	SAVE	S	2	0	11	0	0	4	0
		Function							
parameter	C1	S/(A+E+S)	50	50,00	70,00	57,14	0,00	0,00	43,81
	C2	S/(A+E+S)	33,33	0,00	61,11	x	0,00	57,14	0,00
	C ratio	(C1+C2)/2	42	25	66	29	0	29	22

As was described in Section 3, all items (e.g., a goal) had their own labels in a pattern *n.m*, in which *n* and *m* represent a number and a version of a thing, respectively, created by a certain event.

10 different online management tools, which deal with 10 different activities in Design Thinking, were used to calculate the *D ratio* which represents the level of experimentation. There are 4 steps in establishing its value:

1) Establishing the highest numbers and the highest versions of created items in all 100 online management tools.
2) Calculating sum of products (the highest number multiplied by the highest version of items in every tool).
3) Calculating the *X* parameter as a relative measure of step2 related to step1.
4) Calculating the *D ratio* as the *X* parameter described above multiplied by 100 and rounded to natural figures.

In Table 5 we can see that the average level of experimentation is quite low. The highest value is 30 and it concerns a monolingual group 1 (French). Both other monolingual groups (2 and 3) achieved the level of 25. The multilingual groups are strongly diversified. These results show that all teams did not experiment too much. They created some items in tools and after that, they changed them only a little.

The last, fifth theme of Design Thinking, is diversity which means taking many different activities on the way to a solution. Having quantitative data on team member activities in TransistorsHead, it was possible to calculate how much of their work was diversified. The Gini Coefficient, a measure of statistical dispersion and originally used in economy for estimating the income or wealth distribution of a nation's residents, was used as the E ratio (Druckman & Jackson, 2008).

Table 5. Description of experimentation

	No.	1	2	3	4	5	6	7
	Group name	Les Baguettes	Mean Girls	The Sailors	De Badeendjes	All Gucci	Vindicators	East meets West
	Group type	monolingual	monolingual	monolingual	multilingual	multilingual	multilingual	multilingual
	Nationality	French	American	Finnish	International	International	International	International
Effect of work	**Tool total using**	**2027**	**2188**	**1748**	**3620**	**756**	**931**	**2038**
goal	number	13	13	7	21	4	4	8
	version	12	6	14	11	9	8	11
task	number	28	8	10	8	6	5	20
	version	10	10	9	3	2	5	11
idea	number	2	6	3	5	1	9	2
	version	32	53	29	72	25	8	49
description	number	1	1	3	5	0	0	1
	version	3	7	7	10	0	0	5
option	number	0	4	3	1	0	0	9
	version	0	7	2	4	0	0	14
decision	number	6	5	6	6	3	0	0
	version	11	6	20	10	2	0	0
motivation	number	1	1	2	6	1	1	0
	version	7	3	2	40	1	4	0
solution	number	2	0	2	1	0	0	1
	version	3	0	1	2	0	0	2
meeting	number	1	0	4	5	0	1	0
	version	16	0	1	3	0	2	0
explanation	number	1	0	5	0	0	2	0
	version	1	0	2	0	0	1	0
parameter	sums of products	599	544	442	986	80	137	539
	X	0,295510607	0,248628885	0,252860412	0,272375691	0,105820106	0,147153598	0,264474975
	D ratio	30	25	25	27	11	15	26

In Table 6 there is an *E ratio* for every team which took part in the research. The highest level of diversity was in multilingual group 6 and the lowest level was in monolingual group 3 (Finnish). However, the distance between these two extreme values is not large and it is possible to claim that all teams diversified their work at a middle level.

Table 7 shows all ratios completed together. The average of the ratios, the *DT index* presented at the beginning of this section, demonstrates how much the team used Design Thinking methodology in their work during the study. Additionally, Figure 3 also shows the dispersion of the ratios for all teams.

As is presented in Figure 3, different teams are characterized by different values of ratios. The biggest differences between teams occur in the *C ratio* (problem visualization). On the one hand, the Finnish group 3 (*the Sailors*) used tools to model problems very often, while on the other hand, the multilingual team called *All Gucci* (number 5) did not use them at all. Quite large differences

between teams are also seen in the *B ratio*. While group 7 (multilingual *East meet West*) framed problems quite often, *All Gucci* (number 5) did it very rarely. All groups, no matter whether they were mono- or multilingual, showed similar levels of collaboration and diversity.

Coming back to Table 7 it is necessary to claim that teams differed from each other in the field of ratio dispersion. The parameter called the "coefficient of variation" in Table 7 shows how much the differences are. The most homogenous group is the monolingual group 1 (French). Its coefficient of variation is 20%. At the opposite extreme, the most diversified group is the monolingual group 5. It is possible to conclude that the way of using Design Thinking methodology was different in most of teams and, although there are some similarities, there are however no dominating tendencies.

5. Conclusion

Design Thinking is the new approach to creating innovations, solving problems and finding solutions. The way managers are planning, organizing work, motivating people and controlling their projects is specific. However, Design Thinking methodology creates a framework of activity taken by a leader and team members (Carlgren, Elmquist, & Rauth, 2016).

On the basis of the research results presented in Section 4 it is possible to verify the hypotheses presented in Section 1. As was mentioned above, the verification is only valid for this group of participants.

The first hypothesis (H1) claimed that multilingual teams use more elements of Design Thinking to solve a problem than monolingual teams. In the perspective of the values of the *DT index* in Table 7, this hypothesis can be verified as false. The *DT indexes* for multilingual teams (4, 5, 6 and 7) are not significantly higher than those for monolingual team (1, 2, and 3). The differences are very little and, what is more, two multilingual teams (5 and 6) used relevantly fewer elements of Design Thinking than monolingual ones. What is interesting is that the most active group in Design Thinking methodology was the French monolingual group 1.

Opposite to this, the second hypothesis (H2), which stated that multilingual teams are more diversified in using elements of Design Thinking than monolingual teams, is true. When we take into consideration the coefficient of variations calculated for the *DT indexes* of teams, it seems that generally speaking, monolingual groups (1, 2 and 3) were less diversified than the multilingual ones. However, there are some exceptions, such as group 4 and group 7 (this group was on the brink of the highest level of monolingual group diversification).

Table 6. Description of diversity

	No.	1	2	3	4	5	6	7
	Group name	Les Baguettes	Mean Girls	The Sailors	De Badeendjes	All Gucci	Vindicators	East meets West
	Group type	monolingual	monolingual	monolingual	multilingual	multilingual	multilingual	multilingual
	Nationality	French	American	Finnish	International	International	International	International
	Tools total using	**2027**	**2188**	**1748**	**3620**	**756**	**931**	**2038**
team activities	set goals	548	532	290	815	224	188	409
	describe tasks	689	379	335	301	104	173	484
	generate ideas	355	704	492	1368	253	419	407
	describe ideas	54	119	191	234	37	36	132
	create options	27	176	64	69	29	18	405
	choose options	84	177	152	271	52	15	56
	check motivation	88	45	62	346	30	25	42
	solve conflicts	60	21	38	35	13	13	47
	organize meetings	104	19	61	168	8	23	30
	explain problems	18	16	63	13	6	21	26
parameter	E ratio	56	55	44	54	56	61	48

Table 7. Ratios and DT indexes for all teams

				Ratios							
No.	**Group name**	**Group type**	**Nationality**	**A**	**B**	**C**	**D**	**E**	**DT index**	**Standard deviation**	**Coefficient of variation (%)**
1	Les Baguettes	monolingual	French	40	47	42	30	56	43	9	20
2	Mean Girls	monolingual	American	44	47	25	25	55	39	12	31
3	The Sailors	monolingual	Finnish	26	43	66	25	44	41	15	36
4	De Badeendjes	multilingual	International	47	53	29	27	54	42	12	28
5	All Gucci	multilingual	International	38	18	0	11	56	25	20	82
6	Vindicators	multilingual	International	29	23	29	15	61	31	16	50
7	East meets West	multilingual	International	41	60	22	26	48	40	14	35

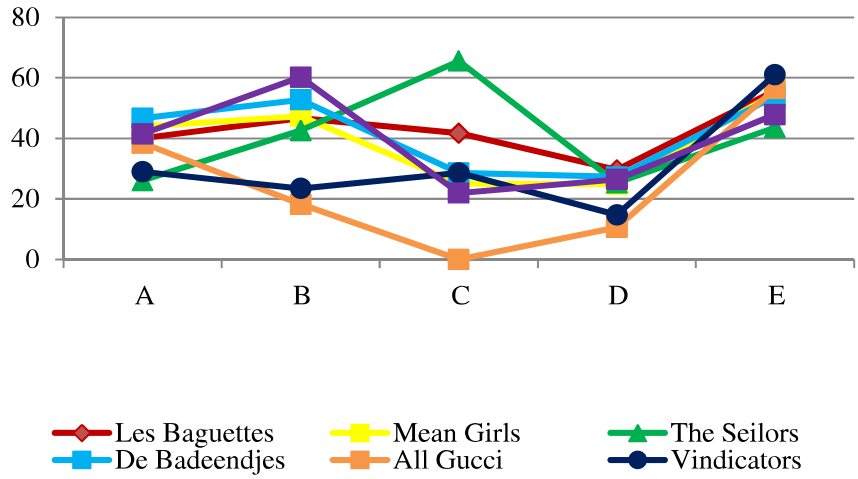

Figure 3. Ratios for all teams

As the average of the coefficient of variation for monolingual groups was 29% and for multilingual groups, it was 48.75%, we can consider monolingual teams are less diversified in using Design Thinking methodology than the multilingual ones.

As was mentioned in Section 3, the data recorded by the 10 online management tools were both qualitative and quantitative. In order to estimate the *DT index,* quantitative data was taken into consideration. The analysis of the research was done on the grounds of the system of organizational terms and its main assumptions which designed the tools available in TransistorsHead. However, compared to other techniques of Design Thinking research (Carlgren et al., 2016), the observation used in the study gave raw data about real activities of a leader and team members and not about their opinions. Its high ability of verifying hypotheses gives an opportunity to conduct quantitative research in areas of management previously engaged by qualitative research.

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Biographical note

Olaf Flak graduated in Management at the University of Economics in Katowice and Electronics at the Silesian University of Technology in Gliwice, Poland. He received his Ph.D. in Economy in 2006. He has been a Deputy Dean for International Affairs and Organization at the Radio and Television Faculty - University of Silesia (since 2016) and an Assistant Professor at the University of Silesia (since 2010). In 2002-2010 he was an Assistant Professor at University of Economics in Katowice in the Faculty of Management. He is a scientist and a specialist in business management, a trainer and a business consultant. His research area is investigating how automatic pattern recognition techniques can be applied in the management of science. He has managed several projects which concerned detection actions taken by a manager and his/her subordinates in an organization by using online management tools and recording information about actions as numeric data. The scientific and practical goal of such pattern recognition is to recognize patterns of users' actions, and finally, generating automatically some prompts and advice for users. In the future, he wants to create an artificial manager who could conduct some operations in team management.