A Twelve-Part Typology of Online Civic Engagement Projects: Sequence Analysis of Civic Engagement in Dutch Municipalities

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Discussion Paper, October 15th, 2025

Abstract: This study examines the sequences of 420 online civic engagement projects by 41 Dutch municipalities using data from the Citizen Lab platform. Drawing on the participatory cube framework, sequence analysis was employed to identify twelve distinct engagement typologies, revealing considerable variation in modes and timing of participation. The findings indicate that online civic engagement is heterogeneous, ranging from brief, individualized activities to prolonged, collaborative processes. This nuanced understanding challenges oversimplified participation categories and offers insights for designing more effective digital engagement. The study also highlights sequence analysis as a useful method for exploring temporal patterns in civic technology contexts.

Keywords: civic engagement, online participation platforms, sequence analysis

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1. Introduction

Public organisations increasingly adopt online participation platforms increasingly as tools to foster dialogue, collect feedback, and involve residents in decision-making processes (Desouza & Bhagwatwar, 2012; Giest et al., 2016). These platforms offer various participatory activities, from polls and surveys to ideation and online workshops (Feeney & Brown, 2017; Falco & Kleinhans, 2018). Although digital platforms offer the potential to expand participation to previously underrepresented groups such as youth, busy caregivers, or individuals with limited mobility—, concerns remain regarding digital divides, moderation quality, privacy, and the risk of echo chambers or participant fatigue (Bertot et al., 2012; Zuckerman, 2014).

Despite the growing use of online civic engagement platforms, most empirical studies have paid limited attention to the specific, sequential combinations of participatory methods and modes that municipalities deploy in real-world projects. This study looks at distinct patterns and typologies that emerge from analysing the sequence of modes in online civic engagement projects. It looks at online civic engagement projects conducted via the CitizenLab platform by Dutch municipalities. Using sequence analysis – a method that captures the temporal patterns and combinations of engagement modes – the paper identifies distinct trajectories in the design and implementation of participatory projects.

This paper is structured as follows. Section 2 situates the study within current debates on digital civic engagement and participatory platforms. Section 3 details the data and methods, including the rationale for employing sequence analysis and the characteristics of the CitizenLab projects studied. Section 4 reports the findings and introduces the twelve-part typology of online civic engagement projects and their key features. Section 5 provides a discussion and conclusions, focusing on the findings' implications, limitations, and recommendations for future research.

2. Theoretical framework

Civic engagement means "any activity where people come together in their role as citizens" (Diller, 2001). Online opportunities have changed the way citizens and governments alike search, find and use information (Giest et al., 2016; Manosevitch, 2014). Various scholars have suggested using the internet for collaboration and civic engagement in local government activities, and local governments are increasingly observed to use technology that enables people

to engage with their neighbourhoods (Desouza & Bhagwatwar, 2012; Ertiö, 2015; Nelimarkka et al., 2014; Williamson & Parolin, 2013; Zavattaro & Sementelli, 2014).

A variety of online tools for local participation exists (Feeney & Brown, 2017; Cho et al., 2021). According to Kersting (2012), governments can conceptualize these digital platforms as invited spaces where citizens can share feedback, ideas, or discussions. Falco & Kleinhans (2018) observe the rise of what they call "digital participatory platforms", which include all the features proper to social media: they are based on Web 2.0, allowing for user generated content, together with the sharing of such content. These platforms also include different and more elaborate technological features, such as data visualization tools, mapping, and aggregation of opinion. Interface design, such as the use of moderation or deliberative polls, support higher-level engagement in discussion forums (Wright & Street, 2007). Furthermore, the asynchronous format may give participants more time to learn about an issue (Evans-Cowley & Hollander, 2010).

Local government use of online tools for civic engagement varies in terms of voice or dialogue on one hand, and influence on decision making on the other (Coleman & Gotze, 2001). Next to this, information provision is an important first step that influences the quality of participatory processes (Farina et al. 2014; Nabatchi, 2012). Scholars proposed multiple frameworks to categorize civic engagement and civic engagement platforms (e.g. Arnstein, 1969; Rowe & Frewer, 2005; Chadwick & May, 2003; Nabatchi, 2012). Most relevant for the present context is the "participatory cube" (Poplin, Pereira, & Rocha, 2013), which consists of three dimensions. First, *access to the space of participation* may be restricted to specific organizations, to organizations devoted to specific themes, or open to all through "freedom to participate." Second, *interactivity of communication* may be one-to-one, one-to-all, or many-to-many. Third, *decision power* may be consultation (choosing between selected options), suggestions (proposing or contributing ideas, information, or opinions), or decision making.

The expectation is that advanced digital technologies will reconnect citizens with decision makers in terms of knowledge and understanding (Conroy & Gordon, 2004), and that that it enhances trust in public organizations – although the evidence for the latter is mixed (see e.g., Åström et al., 2017; Åström, 2020; Evans-Cowley & Hollander, 2010). While technology offers new opportunities for civic engagement, it also presents challenges, for example when it comes to engaging a representative sample of participants (e.g., Graham & Wright, 2014, Nelimarkka et al.,

2014) or encouraging interaction between individuals who hold dissimilar viewpoints (Zuckerman, 2014).

Participation on platforms can be structured with ground rules, moderation, and identification of participants, that in turn may 'nudge' citizens towards deliberation (Van der Does & Bos, 2021). Other research found that while both online and offline participants demonstrated increased knowledge on issues, online discussions were more heated and grounded in existing opinion (Min, 2007). Finally, civic engagement through digital participatory platforms brings up privacy and data protection concerns (Giest et al., 2016).

Given the different options even within a platform, it is possible that at times local governments may use them for polling (consultation) and at other times for more substantive dialogue (suggestion). Researchers assess the quality of online participation platforms using factors such as design, process, outcomes, government involvement, and participants' experiences (Nam, 2012; Leiner & Quiring, 2008; Santini & Carvalho, 2019). However, different forms of participation do not displace old forms of governance but interact with them (Åström, 2020; Newman et al. 2004). Users differ in how much and in what way they want to participate, and therefore a mix of participation types should be employed. Furthermore, it is crucial for local authorities to be aware of limitations and possibilities associated with each participation approach, and the degree of power transferred to users depending on the approach chosen (see e.g., Fors et al., 2021).

Table 1 provides a summary of the modes of participation which could be most identified across different studies addressing digital participatory platforms.

Table 1. Modes of online civic engagement.

Title	Description	Source(s)	Prominent example(s)
Inform	Presenting inputs, outputs, and outcomes created through civic engagement	Arnstein (1969), Falco & Kleinhans (2018a,b), Lee-Geiller & Lee (2019), Nabatchi (2012), Thorsby et al. (2017)	*MindMixer*
Recruit	Offering citizens a sign-up process, for example to get started as a volunteer.	Nugroho et al. (2015), Lee-Geiller & Lee (2019), Thorsby et al. (2017), Van den Berg et al. (2024), Zuiderwijk & Janssen (2014)	
Respond	Obtaining written feedback on analysis, alternatives and/or decisions.	Cho et al. (2021), Falco & Kleinhans (2018a), Karkin & Janssen (2014), Lee-Geiller & Lee (2019), Manoharan et al. (2017), Nabatchi (2012)	*Bang the Table, Metroquest, MindMixer, Peak Democracy/Open Town Hall*
Propose	Enable members to suggest projects on any given topic and gather support	Cho et al. (2021), Nabatchi (2012), Rodriguez Müller (2021)	*Bang the Table, Budget allocator, CitizenLab, IdeaScale, Metroquest, MindMixer*
Meeting	Facilitate (online) spoken real-time deliberation	Cho et al. (2021)	*CitizenLab, Peak Democracy/Open Town Hall*
Survey	Ask questions to understand community needs and expectations	Cho et al. (2021), Falco & Kleinhans (2018), Karkin & Janssen (2014), Lee-Geiller & Lee (2019), Nabatchi (2012)	*CitizenLab, Metroquest, Peak Democracy/Open Town Hall*

Poll	Voting for options to understand community priorities	Anttiroiko (2010), Baxter (2017), Cho et al. (2021), Falco & Kleinhans (2018a), Lee-Geiller & Lee (2019), Nabatchi (2012), Yang (2005)	*Bang the Table, Metroquest, CitizenLab, MindMixer*

Research question

Some research has described these online participatory platforms, categorizing their features (Castellani, D'Orazio, & Valente, 2014; Desouza & Bhagwatwar, 2014; Falco & Kleinhans, 2018; Poplin, Pereira, & Rocha, 2013) and presenting examples (Nelimarkka et al. 2014; Poplin et al. 2013). Cho et al. (2021) have investigated the extent to which local governments are using online participatory platforms. In summary, research has emerged addressing the *mix* of participation methods. However, to the author's best knowledge, no research has addressed the specific *sequence* of events in civic engagement projects through online participatory platforms. This study explores the sequence of events in online citizen participation projects in Dutch municipalities. This explorative study is guided by the following research question:

> *What distinct patterns and typologies emerge from analysing the sequence of modes in online civic engagement projects?*

3. Data and methods

This paper aims to create a typology of online civic engagement projects that resemble each other based on the sequence of the different modes of civic engagement that are used. Sequence analysis is a statistical method that is appropriate to fulfil this aim, as this allows for study in temporally ordered sets of events and to cluster them based on similarity. Contrary to other statistical methods that are used in life course research, such as event-history analysis, sequence analysis does not aim at detecting causal relationships (Abbott & Tsay, 2000). However, the strings of events presented here that occur give a more detailed picture of civic engagement projects in addition to analysing types of engagement (see e.g., Willems et al., 2017) and mixes of engagement methods (see e.g., Cho et al., 2021).

Data collection

This research was conducted on online participatory platforms designed by the company CitizenLab, whose tools have been the subject of a range of case studies (see e.g., Heyder et al., 2021; Rodriguez Müller, 2021; Simonofski et al, 2021; Van Aeken, 2017). CitizenLab offers public organizations a tailored digital platform, which allows citizens to participate in the decision making of their municipality with their computer or mobile devices (Van Aeken, 2017). The platform is able to launch projects using four methods that are grouped as (1) *Consult* (e.g., surveys, polls), *Involve* (e.g., option analysis, mapping), *Collaborate* (e.g., ideation, online

workshops), and *Empower* (e.g., proposals, participatory budgeting) (Citizenlab, 2022a). These methods can be deployed on project pages. Furthermore, in order to provide more structure to project pages, a timeline can be added, which details the different phases in time of a specific project, showing past, current, and future phases and the connected engagement methods in single phases.[2] This sequence analysis concentrates on this timeline. Specifically, I focus on the functionalities that are used on the platform. To be clear, I do not look at the context or the accompanying narrative description. Table 2 summarizes the observed methods, or modes, of civic engagement. After preliminary analyses, it was decided to adopt Process next to the modes of engagement which were evidenced by the literature. To locate the clusters on a grid depicting the mode of communication and the level of civic engagement, these were determined for each mode of engagement based on literature (Nabatchi, 2012; Nelimarkka et al., 2014; Poplin et al., 2013). The grid was constructed by standardizing these variables (Mode of communication, MC, and Level of civic engagement, LCE). The resulting scores for each engagement project were formulated respectively as $\frac{med(x)-\bar{x}MC}{\sigma MC}$ and $\frac{\bar{x}y-\bar{x}LCE}{\sigma LCE}$.

[2] CitizenLab does not allow multiple engagement methods in one timeline phase, and projects cannot have overlapping phases. However, multiple timeline steps or combine participation methods can be created into a project folder (CitizenLab, 2022c).

Table 2. Identified modes of engagement on CitizenLab, linked to the mode of communication and level of civic engagement.

Color	Short title	Description	MC	LCE
	Process	Informing about internal process step.	One to one	1
	Inform	Presenting the inputs, outputs, and outcomes created through online civic engagement	One to one	2
	Recruit	Offering citizens a sign-up process, for example to get started as a volunteer.	One to one	5
	Respond	Obtaining written feedback on analysis, alternatives and/or decisions.	One-to-all	3
	Propose	Enable members to suggest projects on any given topic and gather support	All-to-all	5
	Meeting	Facilitate (online) real-time deliberation	All-to-all	5
	Survey	Ask questions to understand community needs and expectations	One to one	3
	Poll	Voting for options to understand community priorities	One-to-all	4

MC = Mode of communication, Level of civic engagement = LCE

Data collection was conducted in February 2022. First, municipalities using the CitizenLab platform had to be identified. This was done by browsing the municipalities' websites. As CitizenLab was observed to standardize its web addresses for municipalities (e.g., MUNICIPALITY.citizenlab.co), additional URL queries were conducted using Dutch municipality names. Finally, 41 municipalities could be identified making use of CitizenLab services at least on one point in time (11.88% of the municipalities in the Netherlands as of January 2022, inhabited by 15,3% of the total Dutch population). Although there are some differences in terms of population size and urbanization, this sample is representative of Dutch municipalities in terms of education and age composition (see Appendix A for a comparison of the demographic characteristics of the sample and all Dutch municipalities).

Five types of users can use the platform (Citizenlab, 2022bc): (1) visitors (simply view the platform and do not login or register), (2) users or participants (registered on the platform with

Email, Google, or Facebook), (3) project manager (have the rights to manage a project), (4) project Folder manager (have the rights to manage a folder, and all of the projects within the folder), and (5) administrator (have access to the administrator panel). During data collection, the authors navigated the platform as visitor and did not register on the platform. This could influence the number of observations, as although every project standard is visible to everyone, Citizenlab (2022d) offers the option to limit public accessibility of finished participation projects.

The first version of the database included 734 project pages. From this, 449 stand-alone projects were identified, of which 420 also showed the timeline with different project phases. Figure 1 illustrates the number of active participation projects in the sample. The first observed project started in October 2016, whereas the latest end date of one project is set at January 2034. The peak of active observations (October 2021, 179) is situated a few months before data collection. This might indeed suggest that the observed projects do not include all online civic engagement projects by the sample municipalities.

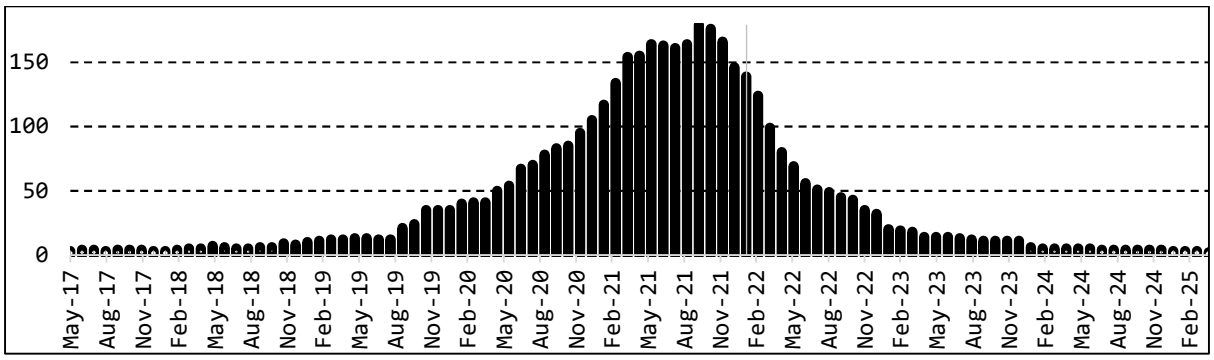


Figure 1. Number of active participation projects in sample (N = 420). Note: the grey line indicates the month of data collection.

To limit the effect of iterative changes that can be applied during the project itself, only participation projects that were "finished" according to the timeline at the time of data collection were considered. The final sample that was used for the sequence analysis consisted of 278 projects.

To assess municipal innovativeness, a 7-point scale index was constructed that measured the municipal adoption of six ICT facilities that are offered at the national level. The services that were used to formulate the technological advancement index are *MO Berichtenbox* (personal mailbox for electronic messages from the government), *Feedback BRP* and *Feedback* HR (contact

point for errors in registry of persons and the commercial register), *Digimelding* (contact point for errors in several records), *GovRoam* (secure WiFi roaming service), and *IPv6* (latest communications protocol providing an identification and location system for computers on networks and routes traffic across the Internet).

The Council for Public Administration (2019), an advisory council to central government and parliament, studied the relationship between policy areas and levels of policy discretion, by examining the extent to which the municipality is free to determine its own policy goals. The degree of policy discretion for a specific policy area was determined by (1) the extent to which the municipality can set additional rules itself, (2) if the area is bound by implementation rules, rules on decision making and (3) whether the municipality is free to choose forms of cooperation. For each component, this could differ between completely free, desirable, mandatory, and compulsory. On a scale of 1 (no discretion) to 10 (full discretion), this resulted in scores for formal policy discretion for the clusters of the municipal fund. After a civic participation project in the sample was assigned to a policy area, the corresponding policy discretion score was assigned to the project (See Appendix B for the number of projects in the sample per policy area and the assigned policy discretion scores). Table 3 shows the descriptive statistics for the sample of municipalities.

Table 3. Descriptive statistics for the sample of municipalities (N = 41).

Variable	Operationalization	Source	N	Mean	SD	Min	Max
Organizational factors							
Policy discretion	Score of the policy area from 1-10	Council for Public Administration, 2019	278	6.831	1.778	2.000	9.000
Financial importance of policy area	% of the policy area of the municipal budget in year *t*	Statistics Netherlands, 2022a	267	11.541	11.373	0.471	51.316
Prior experience with platform	# of days since first CitizenLab project by municipality	Self-collected	278	4,059	12,050	1	44,377
Innovativeness	7-point scale index of adoption of ICT facilities by municipalities	VNG, 2022	41	3.450	0.749	2.000	5.000
Environmental factors							
Population size	Number of inhabitants	Statistics Netherlands, 2022a	41	64,132	98,029	12,228	548,320
Urbanization	Number of inhabitants per km^2	Statistics Netherlands, 2022a	41	1,284	1,516	84	6,650
Education	% inhabitants that graduated	Statistics Netherlands, 2022a	41	3.817	0.988	1.979	7.454
Age 0-20	% of inhabitants younger than 20 years old	Statistics Netherlands, 2022a	41	21.718	2.145	15.500	25.800
Age 20-65	% of inhabitants aged between 20 and 65 years	Statistics Netherlands, 2022a	41	57.083	2.985	53.100	67.500
Age 65-	% of inhabitants aged 65 years and older	Statistics Netherlands, 2022a	41	21.198	3.747	10.500	29.700

Sequence analysis

Sequence analysis has its origin in genetics for the purpose of studying DNA sequences but is also being used in the social sciences for studying longitudinal phenomena (Aisenbrey & Fasang, 2017; Scherer, 2001). A sequence is defined as an ordered list of elements, where an element can be a certain status, a physical object, or an event. The key concept in sequence analysis is the similarity of sequences. The positions of the elements are fixed and ordered by elapsed time or by another natural order.

In order to conduct a sequence analysis on the present data set, the timelines of the civic engagement projects were converted into units of 1 week, and a matrix of the transition rate-based distances was created using the SADI package in Stata (Halpin, 2017).

Optimal Matching (OM) determines similarity by taking into account the number of substitutions and permutations that are needed to make two sequences identical (Abbott & Tsay, 2000). However, conventional OM does not naturally fit with episode data, and is blind to the distinction between deleting all of a one-week episode and deleting a week from a six-week episode. In order to account for these differences, Halpin's (2010) OM algorithm was used, which provides a means of calculating distances by weighting the deletion cost inversely with the length of the sequence.

As transitions occur much less often than once per time unit, I exclude the diagonal, in order to get distances with greater variability. Studer et al.'s (2011) discrepancy measure brings a pseudo–analysis of variance perspective to distance matrices. The pseudo-R-squared and pseudo-F statistic are based on the extent to which the average distance to the centres of the groups are less than the average distance to the centre of the ungrouped distance matrix. Furthermore, in order to assess the distance matrices' uses, it was verified that the distances obeyed the triangle inequality (Halpin, 2014).

Using a pseudo-ANOVA of the distance matrices (see table below), an optimal number of 12 sequence clusters was determined and adopted for the final typology (Halpin, 2017; Studer et al., 2011).

4. Findings

The typology is graphically illustrated using sorted index plots (Scherer, 2001). Figure 2 provides index plots of the 12 initial clusters that were identified.

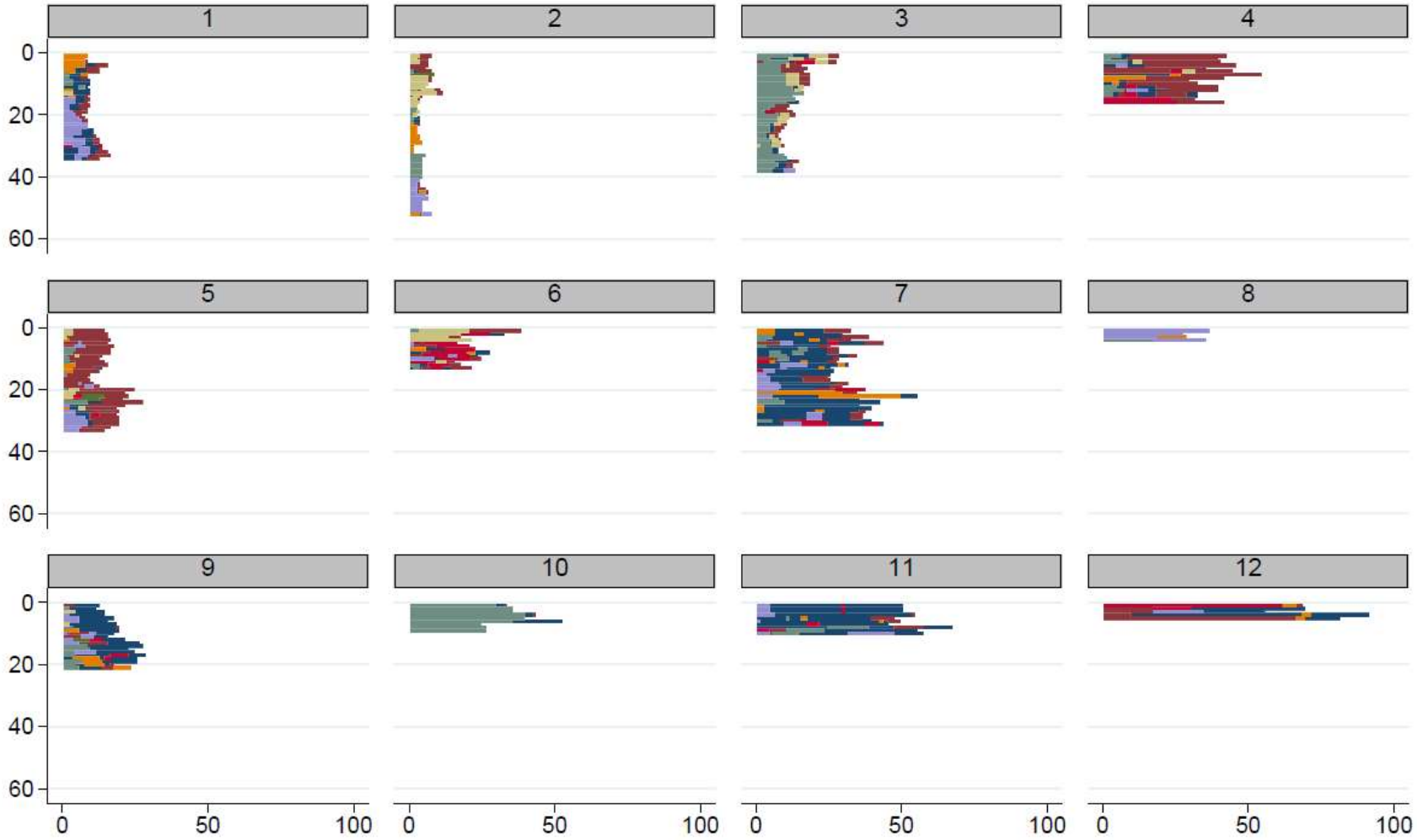


Figure 2. Index plots of clusters identified in the online civic engagement projects. Note: States are denoted using different colors. The x-axis indicates the position (time in weeks), while every point in the y-direction indicates one engagement project.

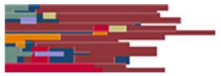
After writing and rewriting initial descriptions, the clusters were re-ordered to enlarge semantical resemblance. Each of the cluster in the typology was provided with a title that fit with its characteristics. The twelve identified clusters of civic engagement are:

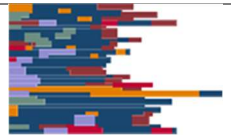
1. **Diversified (short-term)**. Engagement projects in this cluster tend to have short turnaround times and few separate phases with often more than one mode of participation involved.
2. **Diversified (long-term)**. Engagement projects in this cluster 2 tend to have many phases, as well as different modes of participation, but a much longer turnaround time than the previous cluster.
3. **One-trick pony**. This cluster represents the largest share of projects in the sample. The projects are characterised by a short turnaround, few phases, and a singular mode of participation.
4. **Participation by competition**. Projects in this cluster typically start with an engaging mode of participation (e.g., Propose). Then several proposals are selected for voting (Poll), followed by the announcement of the winning proposal (Inform).
5. **Submit and inform (long tail)**. Projects in this cluster tend to have many phases and include many modes of participation. Projects in this cluster mostly start out with an engaging mode of participation, and end with Informing.
6. **Submit and inform (short tail)**. Projects in this cluster mostly start out with an engaging mode of participation, and end with an Informing phase that is shorter than the observations in the previous cluster.
7. **Submit, process, inform**. Projects in this cluster tend to have more phases and different modes of participation but generally end with a processing and an informing phase.
8. **Strictly surveys**. This is the smallest cluster in the sample, and its distinctive characteristic (surveying) is immediately evident. Furthermore, this cluster is characterized by a long turnaround and a limited number of phases.
9. **Slide into process**. Projects in this cluster account for a small number of projects in the sample, although a distinctive feature of this cluster is that the projects mostly end with a long Process phase.
10. **Suggestion box**. Projects in this cluster tend to have few phases and a long turnaround. Timelines in this cluster are characterised by large phases reserved for Propose, on some occasions ending with Inform.

11. **Process-centred**. Projects in this cluster tend to have many phases and different modes of participation, although they mostly consist of phases addressing the Process.
12. **Inform-centred.** Projects in this cluster account for a small number of projects, but have by far the longest turnaround time, although they mostly consist of phases intended to Inform.

A number of additional key statistics is provided in Table 4 (for a more detailed description of each cluster, see Appendix D).

Table 3. Key characteristics of the identified clusters.

Cluster title	Figure	N (% of sample)	Turnaround (weeks)	# phases	# different elements
1. Diversified (short-term)		34 (12.78)	11	2,9	1,2
2. Diversified (long-term)		13 (4.89)	31	5,4	1,6
3. One-trick pony		52 (19.55)	6	1,9	1,1
4. Participation by competition		38 (14.29)	16	3,2	1,1
5. Submit and inform (long tail)		16 (6.02)	43	4,8	1,5
6. Submit and inform (short tail)		33 (12.41)	22	3,4	1,3

7. Submit, process, inform		31 (11.65)	40	4,8	1,5
8. Strictly surveys		4 (1.50)	38	3,0	1,2
9. Slide into process		21 (7.89)	28	4,0	1,3
10. Suggestion box		9 (3.38)	39	2,1	1,0
11. Process-centred		10 (3.76)	53	5,1	1,5
12. Inform-centred		5 (1.88)	84	4,6	1,5

To further enable interpretability of the typology, and inspired by Matijssen & Pavlopoulous (2019), Figure 3 places the clusters on a grid, stratifying the clusters horizontally based on the median mode of communication (*one-to-one*, *one-to-all*, *all-to-all*), and vertically based on the mean level of participation (from 1 = non-participation to 5 = deliberation) (see also Table 3). The clusters were realigned in order to optimize visual representation, and the distance between clusters should not be seen as absolute.

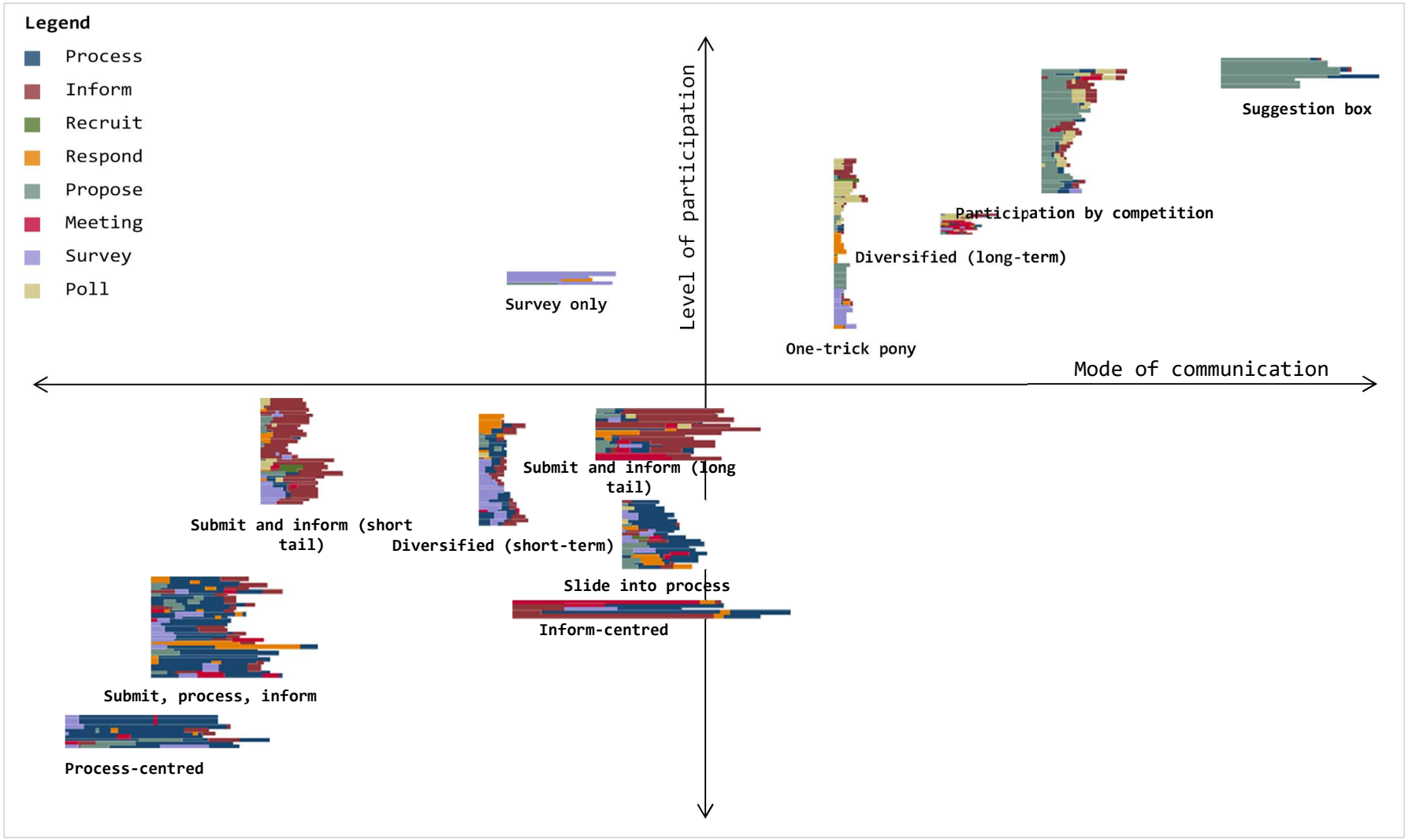

Legend
Process
Inform
Recruit
Respond
Propose
Meeting
Survey
Poll
Level of participation
Mode of communication
Survey only
One-trick pony
Diversified (long-term)
Participation by competition
Suggestion box
Submit and inform (short tail)
Diversified (short-term)
Submit and inform (long tail)
Slide into process
Inform-centred
Submit, process, inform
Process-centred

Figure 1. Clusters of civic engagement projects located on a grid of Mode of communication (x) and Level of participation (

It shows that most clusters are one-to-one, with lower levels of participation. Next to this, with the exception of the "Survey only" cluster, no clusters combine one-to-one communication with a high level of participation, and conversely, no clusters are found in the all-to-all communication mode with low levels of participation; this shows that online civic engagement projects tend to either focus on individualized, lower-engagement methods or on more open, collaborative approaches with higher participation intensity

5. Discussion and conclusion

This study aimed to deepen understanding of the diversity and trajectories of online civic engagement projects initiated by Dutch municipalities through sequence analysis of CitizenLab platform data. By constructing a twelve-part typology of civic engagement sequences, the analysis showed the significant variation in project structures and participatory methods—an insight that challenges the adequacy of simple, generic classifications based solely on participation level or platform type.

Drawing on the participatory cube and related theoretical frameworks (Poplin et al., 2013; Arnstein, 1969; Nabatchi, 2012), the findings demonstrate the need to evaluate civic engagement projects along nuanced axes such as access, interactivity, and decision-making power. The empirical clusters identified in this study reveal that digital participation is not monolithic: some projects emphasize individualized, lower-engagement modes (e.g., "One-trick pony"), while others embrace sustained, varied, or collaborative approaches that maximize participant deliberation ("Diversified long-term" or "Participation by competition"). This complex landscape supports recent scholarship stressing the importance of analysing not just whether people participate, but how, under what conditions, and with what implications for agency, legitimacy, and institutional relationships (Evans-Cowley & Hollander, 2010; Ästrom, 2020).

Methodologically, the application of sequence analysis proved instrumental for uncovering temporally ordered patterns in civic engagement—a contribution that moves beyond snapshot or event-based comparisons (see e.g., Abbott & Tsay, 2000; Aisenbrey & Fasang, 2017). This approach can be generalized to other digital government and civic tech settings, offering practitioners and researchers a flexible tool to cluster, compare, and better understand engagement trajectories.

Limitations and future research

The findings in this paper are subject to a number of limitations. First, this study focuses on observable platform sequences and does not assess direct impacts on policy or citizen outcomes. (Cho et al., 2021). Furthermore, the analysis was restricted to observable platform sequences and did not examine the direct outcomes or societal impact of civic engagement projects, nor the substantive experiences of participants. Additionally, while the sample was broadly representative of Dutch municipalities, engagement patterns and typologies may differ in other platforms or international contexts. As such, Future work should combine sequence analysis with qualitative methods to explore participant experiences.

Explaining why an engagement project would belong to a particular cluster is the step that naturally follows from sequence analysis. However, due to sample size, a multinomial logistic regression could not be conducted.

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Appendix A. Comparison of sampled municipalities and total population of municipalities in 2021.

	Sample municipalities (N = 41)				All municipalities (N = 345)			
Variable	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Population size	64,132	98,029	12,228	548,320	49,798	74,030	931	873,338
Urbanization	1,284	1,516	84	6,650	894	1,063	23	6,650
Higher education	3.817	0.988	1.979	7.454	3.950	1.190	1.602	10.269
Age 0-20 (%)	21.718	2.145	15.500	25.800	21.460	2.350	13.500	28.300
Age 20-65 (%)	57.083	2.985	53.100	67.500	56.380	2.330	47.000	64.500
Age 65- (%)	21.198	3.747	10.500	29.700	21.910	3.360	9.800	32.900

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix B. Policy areas, number of civic engagement projects in sample, linked to policy discretion scores and average financial importance in the 41 sample municipalities.

Policy area	N (%)	Pol. Disc.	Fin. Imp.
Administration and support	6 (2.2)	2	21.8 (7.5)
Safety and security	4 (1.4)	4	3.3 (0.7)
Traffic, transport and water management	37 (13.3)	7	6.3 (2.4)
Economy	6 (2.2)	8	2.9 (5.1)
Education	3 (1.1)	3	4.0 (1.1)
Sport, culture and recreation	65 (23.4)	9	8.5 (1.4)
Social domain	34 (12.2)	4	36.1 (7.9)
Public health and environment	9 (3.2)	4	9.5 (2.0)
Public housing, spatial planning and urban renewal	114 (41.0)	7	7.6 (5.0)

Note: No instances were observed where a project could fit under multiple policy areas.

Appendix C. Sequence analysis: Syntax

Discrepancy-based R^2 and F, 100 permutations for p-value

# Clusters	Pseudo R^2	Pseudo F
5	.3539535	35.74892***
6	.3972567	34.27221***
7	.433184	32.98974***
8	.4579773	31.14212***
9	.4775928	29.36918***
10	.4962027	28.01565***
11	.5120031	26.75443***
12	.5276092	25.79003***
13	.5412521	24.87509***
14	.5529073	23.97242***

** $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$*

Stata syntax 1 (selection of optimal number of clusters)

```
reshape long w, i(ID) j(J)
trans2subs w, idvar(ID) subsmat(tpr1)
matrix list tpr1
trans2subs w, idvar(ID) subsmat(tpr2) diagincl
matrix list tpr2
reshape wide

oma w1-w100, subsmat(tpr1) pwdist(omd1) length(LEN) indel(1.5)
omav w1-w100, subsmat(tpr1) pwdist(omv1) length(LEN) indel(1.5)
sdhollister w1-w100, subsmat(tpr1) pwdist(hol1) length(LEN) timecost(0.5)
localcost(0.5)
twed w1-w100, subsmat(tpr1) pwdist(twd1) length(LEN) lambda(0.5) nu(0.04)

oma w1-w100, subsmat(tpr2) pwdist(omd2) length(LEN) indel(1.5)
omav w1-w100, subsmat(tpr2) pwdist(omv2) length(LEN) indel(1.5)
sdhollister w1-w100, subsmat(tpr2) pwdist(hol2) length(LEN) timecost(0.5)
localcost(0.5)
twed w1-w100, subsmat(tpr2) pwdist(twd2) length(LEN) lambda(0.5) nu(0.04)

metricp omd1
metricp omd2
metricp omv1
metricp omv2
```

```
metricp hol1
metricp hol2
metricp twd1
metricp twd2

clustermat wards omd1, name(omdc1) add
cluster generate o=groups(5 6 7 8 9 10 11 12 13 14)
clustermat wards twd1, name(twd1) add
cluster generate t=groups(5 6 7 8 9 10 11 12 13 14)

clustermat wards omd2, name(omdc2) add
cluster generate oo=groups(5 6 7 8)


sddiscrep o5, distmat(omd1) idvar(ID)
sddiscrep o6, distmat(omd1) idvar(ID)
sddiscrep o7, distmat(omd1) idvar(ID)
sddiscrep o8, distmat(omd1) idvar(ID)
sddiscrep o9, distmat(omd1) idvar(ID)
sddiscrep o10, distmat(omd1) idvar(ID)
sddiscrep o11, distmat(omd1) idvar(ID)
sddiscrep o12, distmat(omd1) idvar(ID)
sddiscrep o13, distmat(omd1) idvar(ID)
sddiscrep o14, distmat(omd1) idvar(ID)

cluster generate o999 = groups(750), name(omdc1) ties(fewer)

reshape long w, i(ID) j(J)

sqset w ID J

sqindexplot, by(o8, note("") legend(off)) order(o999) name(indexplot, replace)
```

Stata syntax 2 (index plot generation)

```
reshape long w, i(ID) j(J)
trans2subs w, idvar(ID) subsmat(tpr1)
matrix list tpr1
reshape wide

oma w1-w100, subsmat(tpr1) pwdist(omd1) length(LEN) indel(1.5)

clustermat wards omd1, name(omdc1) add
cluster generate o=groups(11 12 13 14)

cluster generate o999 = groups(750), name(omdc1) ties(fewer)
```

```
reshape long w, i(ID) j(J)

sqset w ID J

sqindexplot, by(o12, note("") legend(off)) order(o999) name(indexplot,
replace)
```

Appendix D. Descriptive statistics per cluster

1. *Diversified (short-term)*

Short description: Engagement projects in Cluster 1 account for around 1 in 8 projects in the sample and tend to have relatively short turnaround times and few separate phases. This cluster is more frequently concerned with the policy areas of Economy and Safety and security. The most prominent modes of participation are Process, Inform, and Survey. Projects in this cluster mostly end with Informing.		
Figure	**N**	34
	**% of sample**	12.78
	Mode of communication (median)	One-to-one
	Level of civic engagement (mean)	2.26
Sequence characteristics	Turnaround (weeks)	11.0
	No. phases	2.9
	Weeks per phase	3.8
	No. diff. modes	2.5
Policy areas (%)		
Administration and support		2.9
Safety and security		2.9
Traffic, transport and water management		20.6
Economy		5.9
Education		0.0
Sport. culture and recreation		17.6
Social domain		17.6
Public health and environment		0.0
Public housing, spatial planning and urban renewal		32.4
	Contains… (%)	**Ends with…** (%)
Process	34.0	20.6
Inform	26.8	61.8
Recruit	0.0	0.0
Respond	9.3	8.8
Propose	5.2	0.0

Meeting	3.1	2.9
Survey	21.6	5.9
Poll	1.0	0.0

2. ***Diversified (long-term)***

Short description: Engagement projects in Cluster 2 account for a small number of projects in the sample and tend to have a large number of phases, as well as different modes of participation, but a much longer turnaround than Cluster 1. This cluster is more frequently concerned with the policy area of Traffic, transport and water management. The most prominent modes of participation are Meeting, Inform, and Process, and projects also mostly end with these modes.		
Figure	**N**	13
	**% of sample**	4.89
	Mode of communication (median)	All-to-all
	Level of civic engagement (mean)	3.59
Sequence characteristics	Turnaround (weeks)	30.5
	No. phases	5.4
	Weeks per phase	5.7
	No. diff. modes	3.3
Policy areas (%)		
Administration and support		0.0
Safety and security		0.0
Traffic, transport and water management		23.1
Economy		0.0
Education		0.0
Sport. culture and recreation		15.4
Social domain		7.7
Public health and environment		0.0
Public housing, spatial planning and urban renewal		53.8
	Contains… (%)	**Ends with…** (%)

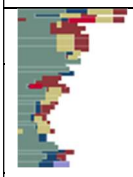
Process	21.4	23.1
Inform	24.3	46.2
Recruit	0.0	0.0
Respond	2.9	0.0
Propose	4.3	0.0
Meeting	30.0	23.1
Survey	5.7	0.0
Poll	11.4	7.7

3. *One-trick pony*

Short description: Cluster 3 represents the largest share of projects in the sample and they tend to have short turnaround times, few phases, and singular modes of participation. This cluster is more frequently concerned with the policy area of Administration and support. The most prominent mode of participation is Inform. Projects in this cluster mostly end with Informing, although the modes of participation are considerably more dispersed than in the other clusters.		
Figure	**N**	52
	**% of sample**	19.55
	Mode of communication (median)	All-to-all
	Level of civic engagement (mean)	3.46
Sequence characteristics	Turnaround (weeks)	5.9
	No. phases	1.9
	Weeks per phase	3.2
	No. diff. modes	1.8
Policy areas (%)		
Administration and support		3.8
Safety and security		0.0
Traffic, transport and water management		7.7
Economy		1.9
Education		1.9

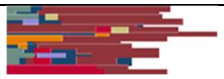
Sport. culture and recreation		21.2
Social domain		9.6
Public health and environment		5.8
Public housing, spatial planning and urban renewal		48.1
	Contains… (%)	**Ends with…** (%)
Process	12.4	5.8
Inform	27.8	30.8
Recruit	2.1	3.8
Respond	11.3	15.4
Propose	16.5	17.3
Meeting	2.1	0.0
Survey	12.4	15.4
Poll	15.5	11.5

4. *Participation by competition*

Short description: Engagement projects in Cluster 4 account for around 1 in 8 projects in the sample. This cluster is more frequently concerned with the policy area of Sport, culture and recreation. Participation projects in this cluster typically start with an engaging mode of participation such as Propose, then a number of proposals is selected for voting (Poll), followed by the announcement of the winning proposal.		
Figure	**N**	**38**
	**% of sample**	14.29
	Mode of communication (median)	All-to-all
	Level of civic engagement (mean)	3.90
Sequence characteristics	Turnaround (weeks)	16.2
	No. phases	3.2
	Weeks per phase	5.0
	No. diff. modes	2.9
Policy areas (%)		
Administration and support		2.6

Safety and security		0.0
Traffic, transport and water management		5.3
Economy		2.6
Education		0.0
Sport. culture and recreation		36.8
Social domain		26.3
Public health and environment		2.6
Public housing, spatial planning and urban renewal		23.7
	Contains… (%)	**Ends with…** (%)
Process	20.5	7.9
Inform	27.0	63.2
Recruit	0.0	0.0
Respond	0.0	0.0
Propose	32.0	13.2
Meeting	1.6	0.0
Survey	0.8	2.6
Poll	18.0	13.2

5. ***Submit and inform (long tail)***

Short description: Engagement projects in Cluster 5 account for a small number of projects in the sample and tend to have relatively many phases, and include many modes of participation. This cluster is more frequently concerned with the policy area of Public housing, spatial planning and urban renewal. The most prominent modes of participation are Inform and Process. Projects in this cluster mostly start out with an engaging mode of participation, and end with Informing.		
Figure	**N**	**16**
	**% of sample**	6.02
	Mode of communication (median)	One-to-many
	Level of civic engagement (mean)	2.42
Sequence characteristics	Turnaround (weeks)	42.9

	No. phases	4.8
	Weeks per phase	9.0
	No. diff. modes	3.1
Policy areas (%)		
Administration and support		0.0
Safety and security		0.0
Traffic, transport and water management		18.8
Economy		0.0
Education		0.0
Sport. culture and recreation		0.0
Social domain		6.3
Public health and environment		0.0
Public housing, spatial planning and urban renewal		75.0
	Contains… (%)	**Ends with…** (%)
Process	32.9	18.8
Inform	34.2	81.3
Recruit	0.0	0.0
Respond	6.6	0.0
Propose	9.2	0.0
Meeting	11.8	0.0
Survey	2.6	0.0
Poll	2.6	0.0

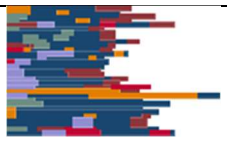
*6. **Submit and inform (short tail)***

Short description: Engagement projects in Cluster 6 account for around 1 in 8 projects in the sample. This cluster is more frequently concerned with the policy areas of Safety and security and Sport, culture and recreation. The most prominent modes of participation is Informing. Projects in this cluster mostly start out with an engaging mode of participation, and end with an Informing phase that is considerably shorter than observed in Cluster 5.		
Figure	**N**	**33**
	% of sample	12.41

	**Mode of communication** (median)	One-to-one
	Level of civic engagement (mean)	3.59
Sequence characteristics	Turnaround (weeks)	21.9
	No. phases	3.4
	Weeks per phase	6.5
	No. diff. modes	2.6
Policy areas (%)		
Administration and support		0.0
Safety and security		6.1
Traffic, transport and water management		15.2
Economy		0.0
Education		0.0
Sport. culture and recreation		39.4
Social domain		3.0
Public health and environment		6.1
Public housing, spatial planning and urban renewal		30.3
	Contains… (%)	**Ends with…** (%)
Process	11.6	3.0
Inform	50.9	97.0
Recruit	1.8	0.0
Respond	5.4	0.0
Propose	7.1	0.0
Meeting	3.6	0.0
Survey	10.7	0.0
Poll	8.9	0.0

7. *Submit, process, inform*

Short description: Engagement projects in Cluster 7 account for around 1 in 8 projects in the sample and tend to have relatively many phases and different modes of participation. This cluster is more frequently concerned with the policy area of Safety and security. The most

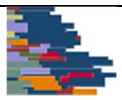
prominent mode of participation is Process. Projects in this cluster mostly end with Informing.		
Figure	**N**	31
	% of sample	11.65
	Mode of communication (median)	One-to-one
	Level of civic engagement (mean)	1.78
Sequence characteristics	Turnaround (weeks)	40.3
	No. phases	4.8
	Weeks per phase	8.3
	No. diff. modes	3.2
Policy areas (%)		
Administration and support		0.0
Safety and security		3.2
Traffic, transport and water management		12.9
Economy		3.2
Education		3.2
Sport. culture and recreation		19.4
Social domain		6.5
Public health and environment		0.0
Public housing, spatial planning and urban renewal		51.6
	Contains… (%)	**Ends with…** (%)
Process	46.0	32.3
Inform	19.3	64.5
Recruit	0.0	0.0
Respond	10.0	0.0
Propose	7.3	0.0
Meeting	6.7	3.2
Survey	9.3	0.0
Poll	0.0	0.0

8. ***Strictly surveys***

Short description: Cluster 8 is the smallest cluster and accounts for very few projects in the sample. Projects in this cluster are characterized by relatively long turnaround and a limited number of phases. This cluster mostly concerns the policy area of Social domain and Traffic, transport and water management. The most prominent mode of participation is Survey.		
Figure	**N**	4
	**% of sample**	1.50
	Mode of communication (median)	One-to-one
	Level of civic engagement (mean)	3.24
Sequence characteristics	Turnaround (weeks)	38.3
	No. phases	3.0
	Weeks per phase	12.8
	No. diff. modes	2.5
Policy areas (%)		
Administration and support		0.0
Safety and security		0.0
Traffic, transport and water management		25.0
Economy		0.0
Education		0.0
Sport. culture and recreation		0.0
Social domain		50.0
Public health and environment		0.0
Public housing, spatial planning and urban renewal		25.0
	Contains… (%)	**Ends with…** (%)
Process	16.7	0.0
Inform	8.3	0.0
Recruit	0.0	0.0
Respond	8.3	25.0
Propose	16.7	25.0
Meeting	8.3	0.0

Survey	41.7	50.0
Poll	0.0	0.0

*9. **Slide into process***

Short description: Engagement projects in Cluster 9 account for a small number of projects in the sample. This cluster is more frequently concerned with the policy area of Economy and Traffic, transport and water management. The prominent mode of participation is Process, and projects in this cluster also mostly end with Process.		
Figure	**N**	21
	**% of sample**	7.89
	Mode of communication (median)	One-to-one
	Level of civic engagement (mean)	2.00
Sequence characteristics	Turnaround (weeks)	28.0
	No. phases	4.0
	Weeks per phase	7.1
	No. diff. modes	3.0
Policy areas (%)		
Administration and support		4.8
Safety and security		0.0
Traffic, transport and water management		28.6
Economy		4.8
Education		0.0
Sport. culture and recreation		23.8
Social domain		9.5
Public health and environment		0.0
Public housing, spatial planning and urban renewal		28.6
	Contains… (%)	**Ends with…** (%)
Process	45.8	85.7
Inform	13.3	9.5
Recruit	1.2	0.0

Respond	7.2	4.8
Propose	10.8	0.0
Meeting	8.4	0.0
Survey	10.8	0.0
Poll	2.4	0.0

10. ***Suggestion box***

Short description: Engagement projects in Cluster 10 account for a small number of projects in the sample and tend to have few phases, a relatively long turnaround, and few different modes of participation used. This cluster is more frequently concerned with the policy area of Sport, culture and recreation, Social domain, and Public health and environment. The most prominent modes of participation are Propose, Process, and Inform. Projects in this cluster mostly end with Inform and Propose.		
Figure	**N**	9
	**% of sample**	3.38
	Mode of communication (median)	All-to-all
	Level of civic engagement (mean)	4.77
Sequence characteristics	Turnaround (weeks)	39.4
	No. phases	2.1
	Weeks per phase	18.7
	No. diff. modes	2.1
Policy areas (%)		
Administration and support		0.0
Safety and security		0.0
Traffic, transport and water management		0.0
Economy		0.0
Education		0.0
Sport. culture and recreation		55.6
Social domain		33.3
Public health and environment		11.1

Public housing, spatial planning and urban renewal		0.0
	Contains… (%)	**Ends with…** (%)
Process	26.3	11.1
Inform	21.1	44.4
Recruit	0.0	0.0
Respond	0.0	0.0
Propose	47.4	44.4
Meeting	5.3	0.0
Survey	0.0	0.0
Poll	0.0	0.0

11. ***Process-centred***

Short description: Engagement projects in Cluster 11 account for a small number of projects in the sample and tend to have relatively many phases and different modes of participation. This cluster is more frequently concerned with the policy area of Administration and support and Public health and environment. The most prominent modes of participation is Process, and projects in this cluster also mostly end with Process.		
Figure	**N**	10
	**% of sample**	3.76
	Mode of communication (median)	All-to-all
	Level of civic engagement (mean)	1.55
Sequence characteristics	Turnaround (weeks)	53.4
	No. phases	5.1
	Weeks per phase	10.5
	No. diff. modes	3.4
Policy areas (%)		
Administration and support		10.0
Safety and security		0.0
Traffic, transport and water management		20.0
Economy		0.0

Education		0.0
Sport. culture and recreation		10.0
Social domain		0.0
Public health and environment		20.0
Public housing, spatial planning and urban renewal		40.0
	Contains… (%)	**Ends with…** (%)
Process	49.0	70.0
Inform	15.7	30.0
Recruit	0.0	0.0
Respond	3.9	0.0
Propose	7.8	0.0
Meeting	9.8	0.0
Survey	13.7	0.0
Poll	0.0	0.0

12. ***Inform-centred***

Short description: Engagement projects in Cluster 12 account for a very small number of projects in the sample and have by far the longest turnaround time. This cluster is more frequently concerned with the policy area of Education and Public housing, spatial planning and urban renewal. The most prominent modes of participation are Process and Inform.		
Figure	**N**	5
	**% of sample**	1.88
	Mode of communication (median)	One-to-many
	Level of civic engagement (mean)	2.35
Sequence characteristics	Turnaround (weeks)	84.3
	No. phases	4.6
	Weeks per phase	18.3
	No. diff. modes	3.0
Policy areas (%)		
Administration and support		0.0

Safety and security		0.0
Traffic, transport and water management		0.0
Economy		0.0
Education		20.0
Sport. culture and recreation		20.0
Social domain		0.0
Public health and environment		0.0
Public housing, spatial planning and urban renewal		60.0
	Contains… (%)	**Ends with…** (%)
Process	39.1	80.0
Inform	34.8	20.0
Recruit	0.0	0.0
Respond	13.0	0.0
Propose	0.0	0.0
Meeting	8.7	0.0
Survey	4.3	0.0
Poll	0.0	0.0