



# Technology legitimation in the public discourse: applying the pillars of legitimacy on GM food

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## ABSTRACT

The public sphere, reflected by the public discourse, is an important domain for the legitimation of technology. In the institutional literature, four pillars of legitimacy are distinguished: normative, cognitive, regulative, and pragmatic. The aim of this study was to investigate to what extent these pillars can be used as a framework for analysing the legitimation of technological innovations in the public discourse. We conducted a qualitative media analysis of the case of GM food in the Netherlands, analysing 287 articles from nine Dutch newspapers in the period of 1996–2016. The results show that the pillars provide insight into legitimacy in a multi-dimensional way and serve as a structure for the dynamics of legitimation processes. Regarding GM food, the public debate was pre-dominantly negative, with a strong focus on the normative pillar. Emotional rhetoric exceeded knowledge and understanding (cognitive pillar) of GM food. The regulative and pragmatic pillars were hardly addressed.

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## Introduction

As technological innovations can have a major impact on society, it is important to create legitimacy among the general public. Legitimacy can be described as ‘being perceived as desirable, proper, and appropriate within some socially constructed system of norms, values, beliefs, and definitions’ (Suchman 1995, 574). In the case of radical innovations, such as GM food, proponents have to spend considerable efforts on creating legitimacy as they are often received with major doubts about their utility due to their ‘liability of newness’ (Binz et al. 2016; Petkova, Rindova, and Gupta 2013).

The public sphere is an important domain for the legitimation of technological innovations. It functions as a core element in modern democracies, enabling citizens to access information, observe decision-makers, form judgements of societal developments, and articulate their views and opinions (Gerhards and Schäfer 2009). This collective process of sense making is reflected by the public discourse. Mass media play a pivotal role in the public sphere, as they are both reflecting and influencing the public discourse through their selection of topics and applied frames (Malett et al. 2018). In the context of technological innovations, positive expectations dominating the public discourse are an indication of high legitimacy, while the articulation of negative expectations or no reference at all is an indication of a lack of legitimacy (Bergek, Jacobsson, and Sandén 2008).

Legitimacy is not a static process and should be treated as a multi-dimensional variable with different characteristics and dynamics that might change over time (Binz et al. 2016). In the

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institutional domain, scholars have extensively studied the dynamics of legitimacy (e.g. Johnson, Dowd, and Ridgeway 2006; Scott 2013; Suchman 1995). From these studies, it has become clear that four pillars of legitimacy can be distinguished, the cognitive, normative, pragmatic, and regulative pillars, all of which reflect a different dimension of legitimacy. Binz et al. (2016) used these four pillars as a framework for technology legitimization of potable water reuse among various stakeholders. In the context of renewable energy technologies for transport, Bergek, Jacobsson, and Sandén (2008) emphasised that when advocates of renewable technologies are not able to influence legitimacy in one pillar (e.g. regulative), they can try to influence the other (e.g. normative).

The aim of this study is to apply the pillars of legitimization as a framework for analysing media articles, to enhance our understanding of technology legitimization in the public sphere. By developing such a framework, the legitimization processes of different technological innovations can be compared. As this research is explorative in nature, we conducted a case study focusing on genetically modified (GM) food.

### ***The case of GM food***

GM food has been the subject of public controversy ever since its first application in the 1970s (Gutteling et al. 2006), which makes it an interesting subject for studying the legitimization processes. GM foods are food products containing, consisting of, or produced from GMO. GM crops and foods are believed to offer a range of benefits, including lower pesticide costs, less environmental pollution from pesticides and herbicides, higher productivity, and new crop varieties to alleviate hunger in developing countries (Gaskell et al. 2004). However, much opposition has risen from organisations, interest groups, and the general public concerning environmental risks and food safety (De Jong et al. 2000; Frewer et al. 2004). In the Netherlands, the general public is rather ambivalent towards biotechnology, without extremely negative or positive reactions. Although there has been a declining support for the implementation of GM food (from 59% in 1996 to 30% in 2010), the Netherlands is still among the European countries with the highest support, along with the United Kingdom, Portugal, Spain, Ireland, and Denmark (European Commission 2010). Nevertheless, there seems to be a lack of knowledge among the general Dutch public in regard to GM food and crops (Hanssen et al. 2015; Lucht 2015); which, as Gaskell et al. (2004) argue, could lead to emotional and irrational opinions.

## **Theoretical background**

### ***Public discourse***

Legitimacy is embedded in widely shared cultural beliefs from the surrounding society, therefore it is important to consider the public discourse. With regard to technological innovations, Bergek, Jacobsson, and Sandén (2008) found that public discourse is one of the shaping processes of legitimization. As actor groups may have different expectations, they compete with each other to influence the public discourse by using different frames (Geels and Verhees 2011). Consequently, these competing frames are reflected in the public discourse and affect attitudes, feelings, and actions of other relevant actors. These actions include mobilising resources from investors and policy makers, political protections, and support from the general public (Jansma, Gosselt, and de Jong 2017).

In an attempt to gain insights into legitimization processes, various innovation scholars have studied the public discourse on technological innovations by means of media analysis (e.g. Markard, Wirth, and Truffer 2016; Smink et al. 2015; Zschache, Von Cramon-Taubadel, and Theuvsen 2010). Through deliberative coverage of news, mass media have the ability to set the agenda for public debate. In particular, traditional media are seen as an authoritative source of information, thereby creating social facts (Malett et al. 2018). Journalists not only set the agenda, but also influence and shape the information discussed in the public debate by the frames that they apply in their reporting.

Reese (2001) emphasises that studying the concept of framing is a useful approach, as it has the potential to get beneath the surface of news coverage and expose the hidden assumptions.

In the framing literature, both generic frames and issue-specific frames are studied. While generic frames are abstract and applicable to a wide range of topics, issue-specific frames are more concrete and usually exclusively identified in relation to a certain topic (Brugman, Burgers, and Steen 2017). Scholars (e.g. Borah 2011; Brugman, Burgers, and Steen 2017) have advocated for studying generic frames, as it allows for the identification of patterns over time and across topics. Furthermore, comparing and generalising results is much easier with generic frames than with issue-specific frames.

To date, there is no generic framework available for analysing and understanding the legitimisation processes of technological innovations in the public discourse. Most of the media analyses in this domain are either quantitative studies focusing on prominence and sentiment (e.g. Binz et al. 2016; Markard, Wirth, and Truffer 2016) or qualitative case studies focusing on descriptions of events (e.g. Flipse and Osseweijer 2012; Smink et al. 2015; Zschache, Von Cramon-Taubadel, and Theuvsen 2010). Both designs have their advantage and disadvantage. Quantitative studies indicate the prominence of an innovation in the public agenda and provide the opportunity to compare technological innovations. However, these studies do not provide insights into the actual processes of gaining legitimacy in the public discourse. Qualitative media analyses provide insights into case-specific content written about an innovation, but make it difficult to compare different innovations. Furthermore, solely describing events and linking these to legitimacy might overlook important domains in which technological developments should be accepted. Therefore, our aim is to investigate whether the four pillars of legitimacy can serve as a framework for analysing the public discourse on science and technology and the structure of the dynamics of the legitimisation processes.

### ***Four pillars of legitimacy***

In the institutional literature, several types of legitimacy are delineated. Suchman (1995) distinguished three types, cognitive, moral, and pragmatic legitimacy, all of which involve a generalised perception or assumption of legitimacy but rest on somewhat different behavioural dynamics. Ruef and Scott (1998) combined pragmatic and cognitive legitimacy, renamed moral as 'normative' legitimacy, and added the regulative component. Scott (2013) later continued with these three elements and defined them as 'pillars'. Other scholars combined Suchman and Ruef and Scott's distinctions into four pillars of legitimacy: cognitive, moral or normative, pragmatic, and regulative (e.g. Binz et al. 2016; Walker, Schlosser, and Deephouse 2014).

When aligned, the strength of the pillars' combined forces is at its highest. However, when the pillars are misaligned, they can cause confusion and conflict (Scott 2013). The four pillars of legitimacy do not constitute a hierarchy. In fact, within a time-frame, they often co-exist or overlap (Suchman 1995).

### ***Cognitive legitimacy***

Cognitive legitimacy involves the spread of knowledge regarding a technological innovation to social audiences (Aldrich and Fiol 1994). Two variants of cognitive legitimacy can be identified, legitimacy based on comprehensibility and legitimacy based on taken-for-grantedness (Suchman 1995). In the case of technological innovations the former is about understanding the working principles of the innovation (Scott 2013). The latter arises when the innovation itself becomes an integral part of the dominant institutional framework in a particular social system (Kaganer, Pawloski, and Wiley-Patton 2010). Taken-for-grantedness can be viewed as the highest form of legitimacy, as it is implied that the innovation is embedded in the institutional system, and it is unthinkable to have a system without the innovation (Aldrich and Fiol 1994). This form of cognitive legitimacy is rarely attainable in the early stages of innovation diffusion. In the context of GM food, the innovation is still widely contested and not yet integrated into the social system. Therefore, the focus in this study will be on the comprehensibility part of cognitive legitimacy: the degree to which a technology is known and understood.

### *Normative legitimacy*

Normative legitimacy involves judgements about whether an innovation is right for society (Suchman 1995). These judgements are based on norms and values that are socially constructed over time. According to Scott (2013, 64) values are 'conceptions of the preferred or desirable, together with the construction of standards to which existing structures or behaviours can be compared and assessed', while norms specify legitimate ways of how and which technologies should be developed. Ultimately, when normative legitimacy is achieved in its highest form, these judgements are perceived as objective and natural by the actors. The emphasis of the normative pillar is on promoting broad pro-social logics of justice and welfare (Suchman 1995). In the context of GM food, opposing arguments are often infused with a highly emotional and moralising rhetoric, with a focus on societal justice instead of individual gains (Hielscher et al. 2016). This rhetorical approach indicates a prominence of the normative pillar.

### *Pragmatic legitimacy*

Pragmatic legitimacy rests on the self-interested calculations of the innovation's most immediate audiences (Suchman 1995). It is about the utility that a technological innovation has for its stakeholders (Binz et al. 2016). This utility can be either of direct value to the stakeholder group or of more indirect value, being responsive to larger interests and goals (Suchman 1995). Whereas normative legitimacy focuses on the utility for society, pragmatic legitimacy focuses on stakeholders' self-interest, 'what's in it for me' (Walker, Schlosser, and Deephouse 2014). Kaganer, Pawloski, and Wiley-Patton (2010) argue that this type of legitimacy plays an important role in shaping the early stages of the diffusion of an innovation, as stakeholder groups will adopt an innovation only if they see a (potential) value in it. In the organisational context, Suchman (1995) argues that pragmatic legitimacy is the easiest form to manipulate for organisations, as it reflects direct exchange and relations of influence between a focal organisation and its specific constituents. However, with regard to technological innovations, especially contested ones such as GM food, the field is much more diffuse as a larger and more diverse group of stakeholders are involved, and a clear agent is often lacking.

### *Regulative legitimacy*

Regulative legitimacy is associated with the alignment of new practices with existing rules, laws, and regulations that are created by governments, credential associations, professional bodies, or powerful organisations (Zimmerman and Zeitz 2002). Technologies that conform to existing rules, laws, and regulations, arguably possess a higher level of regulative legitimacy than technologies that are not in line with them (Binz et al. 2016). In the case of radical innovations, rules and regulations often do not exist, which makes (lobbying) activities that influence and shape policy-making especially relevant (Jansma, Gosselt, and de Jong 2017). When GM food was in its early developmental phases, there was no clear regulatory framework. Only later was the policy set on a European level, and since then, it has been further extended and refined. Opponents and proponents of GM food have tried to shape and influence this regulatory process (Frewer et al. 2004).

## **Method**

### *Design and instrument*

By using the four pillars of legitimacy (cognitive, normative, pragmatic, and regulative) as a framework to study the media coverage of GM food, our aim was twofold. First, we wanted to investigate whether these pillars can be used as a framework for structuring the public discourse on technological innovations to gain insights into the legitimacy process as a whole. Second, we were interested in the dynamics of these pillars. For example, whether the pillar that is the most apparent is also the most contested one or the most agreed upon or whether specific arguments are used in a pillar either in favour of or against the innovation. By analysing these dynamics, we aim to enhance our

understanding of the process of technology legitimation: the actors and arguments involved in making an innovation legitimate or preventing it from becoming legitimate.

## **Corpus**

The corpus for the media analysis consisted of all articles on GM food that were published in all Dutch national newspapers ( $N = 9$ ) between 1996 and 2016. Articles were collected using the LexisNexis Academic Database. The starting year, 1996, was chosen as this was the first time that newspapers explicitly started using the term 'genetisch gemodificeerd voedsel' (GM food in Dutch). The last year of coverage, 2016, was the last full year available in the database at the time of our analysis. In total, 372 articles, containing the term were included in our corpus. This specific term is the most commonly used term in Dutch and was therefore most likely to produce an adequate sample of all articles on the topic. During the analysis, irrelevant articles (i.e. articles in which GM food was mentioned without any further information about it) were excluded from the sample, resulting in a total corpus of 287 articles.

## **Analysis**

For the analysis a codebook was created that consisted of codes for identifying the article and the overall sentiment and codes for analysing the pillars of legitimacy, including the dynamics of these pillars (see [Table 1](#)). Identification elements, including date and year, and newspaper are relevant as they give insights in the timeline of the public discourse on GM food and the newspapers that reported about it. The unit of analysis of these codes was the whole article. Codes to identify the pillars of legitimacy and the dynamics of these pillars included the four pillars based, the sentiment in these pillars, arguments in favour or against GM food, and stakeholders. The pillars were based on the literature, and the unit of analysis was every text part in an article that could be linked to a specific pillar. In every coded pillar, arguments were coded based on statements that were either in favour of or against GM food. The arguments were derived from the 'Arguments card on biotechnology' developed by the Ministry of Housing, Spatial Planning, and the Environment (Rijksoverheid 2009). The stakeholders were inductively identified based on the media-articles.

The media articles were coded by one of the authors. To indicate measurement consistency, inter-coder reliability was based on ten percent of the corpus. One round of coding was conducted with a social science researcher who was not linked to this study, to prevent any biases. This resulted in substantial agreement on all codes (see [Table 1](#)).

## **Results**

In this section the results of the media analysis are discussed. First, a holistic perspective on the development of the pillars over time will be given. Next, the dynamics of the pillars will be discussed in the order of the frequency of the pillars.

### **General overview**

Several events and actions affected the GM food debate. When the events were described, it was mostly in a negative way (see [Figure 1](#)), and the normative pillar was mostly addressed, focusing on whether it is 'right' to implement GM food in the society or not (see [Figure 2](#)). News media focused less on the explanation and technical details of GM food (cognitive pillar), the potential benefits (pragmatic pillar), and the laws and the regulatory process (regulative pillar). In a media article, the cognitive pillar and the normative pillar often co-existed with each other, and with the pragmatic and regulative pillar (see [Table 2](#)). Articles addressing only one pillar often addressed

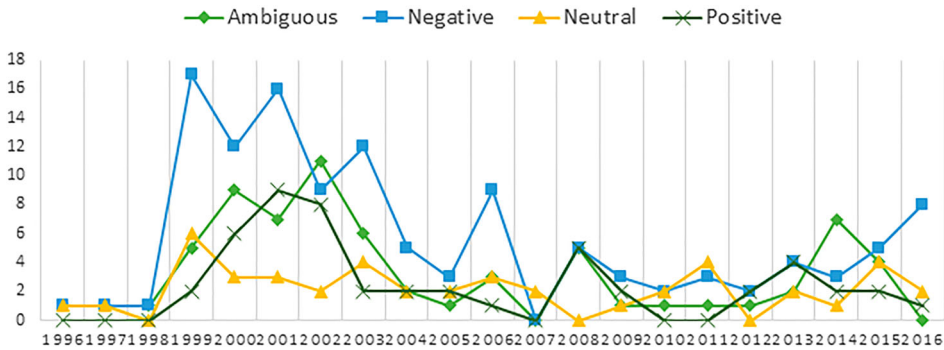
**Table 1.** Coding scheme.

Code	Description	Unit of analysis	Cohen's Kappa
Date and year		Article	/
Newspaper		Article	/
Overall sentiment		Article	0.90
Positive	Mainly positive statements about GM food.		
Neutral	No preference in favour or against GM food.		
Negative	Mainly negative statements about GM food.		
Ambivalent	Both positive and negative statements about GM food.		
Pillars of legitimacy	Text parts which can be directly or indirectly linked to GM food	Pillar (sentences linked to a specific pillar)	0.67
Cognitive	Knowledge and information about GM food, including its description, explanation of its working principles, and (scientific) studies about its (potential) effects.		
Normative	Moral judgements about GM food; whether it is 'right for society'; including value judgements, norms and beliefs.		
Pragmatic	Utilitarian judgement on GM food, practical advantages and disadvantages for particular stakeholders.		
Regulative	Descriptions and judgements of rules and regulations on GM food by the government or other formal authorities.		
Sentiment of pillar		Pillar (sentences linked to a specific pillar)	0.66
Positive	Only positive statements about GM food are made.		
Neutral	No reference to positive or negative statements.		
Negative	Only negative statements about GM food.		
Ambivalent	Both negative and positive statements about GM food.		
Arguments		Sentence	0.82
Ecology	Whether GM food is good or bad for the environment, including: crops, biodiversity, and harvests.		
Economy	Whether GM food is good or bad for the economy, including: gross national product, profits, and food prices.		
Ethics	Whether the use of GM food is right or wrong, including: religion, prevention of famine, and food shortage.		
Public health	Whether GM food harms human health or not, including: pesticides, allergic reactions, and (unknown) consequences of GM food.		
Stakeholders EU		Sentence	0.85
Dutch government			
EU governments (besides NL)			
US government			
NGOs			
Biotechnology companies			
Research institutes			
Farmers			
Companies			
Shareholders			
Investors			
General public			
Media			
Other			

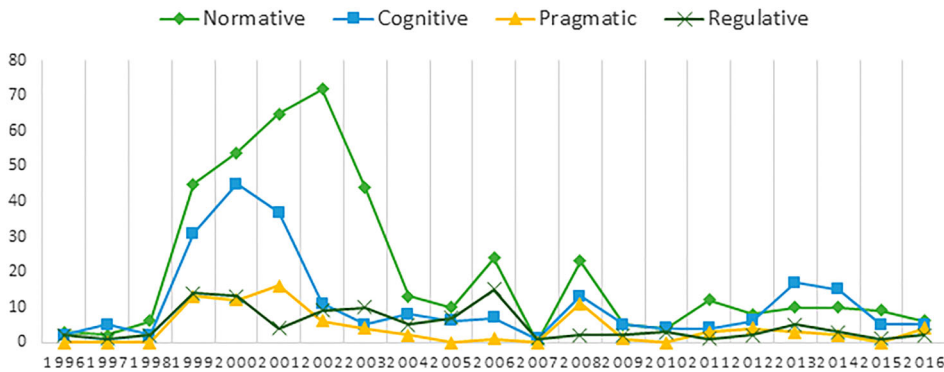
the normative pillar, and hardly addressed the pragmatic pillar. This co-occurrence was not time-bound, but rather could be linked to the type of article (longer opinionated and background articles).

In the pillars, all four types (ecological, economic, ethical and public health) of arguments appeared, but the frequency and the types of arguments differed per pillar (see [Figure 3](#)). In the cognitive and pragmatic pillars, there were relatively many arguments present, in comparison with the normative and regulative pillars.

Among the stakeholders, the general public, NGOs, and the EU government were mentioned the most (see [Figure 4](#)). Other stakeholders that were often mentioned were research institutes, private



**Figure 1.** Sentiment toward GM food.



**Figure 2.** Frequency of the pillars of legitimation.

companies (other than biotech companies), biotech companies, and the Dutch government. Several other stakeholders that were coded (the US government, media, investors, shareholders) were less addressed by the media.

### Normative legitimacy

Over the years, the normative pillar has been most often addressed by the news media (see Figure 2). A number of events dominated this pillar. These events were described from a perspective that focused on the question of whether GM food is right for society or not. In this pillar, the public discourse was predominantly negative (see Figure 1). Although relatively few explicit arguments were mentioned by the media in this pillar, all four areas of argumentation were present.

In the period from 1996 to 2003, the public discourse was affected by multiple campaigns that were set up to emphasise that GM food was ‘not right’, using the arguments that GM food is against the values and norms of society and that it is harmful for the environment or human

**Table 2.** Frequency of the co-occurrence of pillars in an article.

	Cognitive	Normative	Pragmatic	Regulative
Cognitive	38 <sup>a</sup>	85	40	35
Normative		93 <sup>a</sup>	41	46
Pragmatic			5 <sup>a</sup>	13
Regulative				13 <sup>a</sup>

<sup>a</sup>Only this pillar was addressed in the media article.

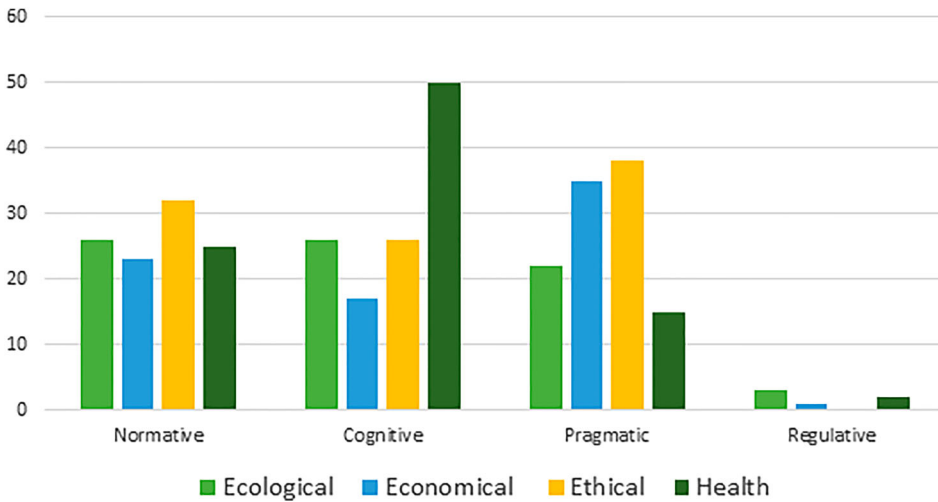


Figure 3. Pillars of legitimation and arguments.

health, or not using any specific arguments. During these campaigns, GM crop fields were destroyed, protests increased, and activists attacked companies for using genetically modified ingredients in their products. Biotech companies were highly criticised in the media. In addition, the Dutch media reported on the British debate on GM food. Following the British media, in 2001 the Dutch media introduced the term ‘Frankenstein food’ into the public debate as a reference to GM food. In the same period, the media reported on developments in GM food in the US. Already in the 1990s the US was much more open to implementing GM food and allowed the growing of GM crops. The Dutch media reported about these developments mostly in a negative way.

Following the debate in the public sphere, a normative debate started to arise in the political sphere as well. This debate was mainly at the European level and was centred around the moratorium and regulations on food labelling. The media mainly addressed proponents of both policies, who emphasised that establishing appropriate measures was the right thing to do for European citizens. They used arguments in favour of these measures based on health risks that were not clear yet and

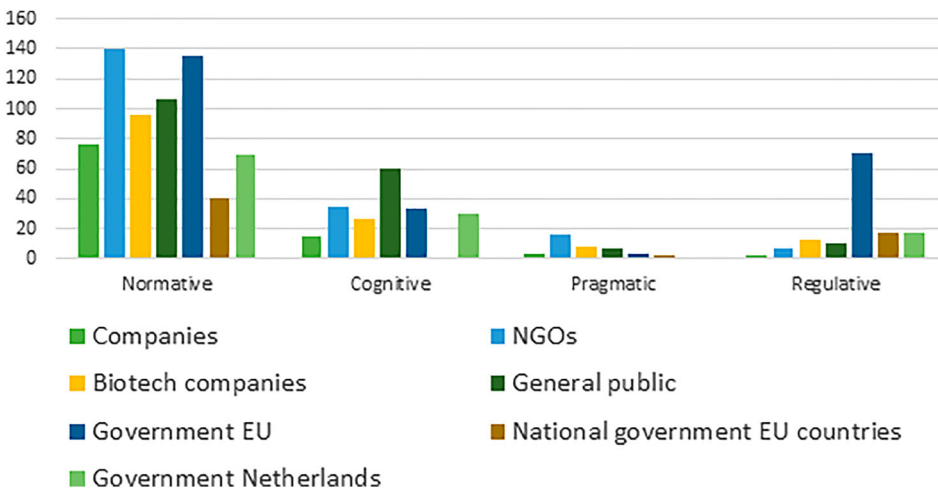


Figure 4. Pillars of legitimation and stakeholders.



from an ethical point of view, including the view that human beings should not mess with nature, or they did not use any argumentation.

### ***Cognitive legitimacy***

Knowledge and understanding of GM food, and thus the cognitive pillar, are seen as a crucial factors for gaining legitimacy. However, the cognitive pillar was far less addressed in the public discourse than the normative pillar (see [Figure 2](#)). Overall, the sentiment was negative but it was much more balanced with ambivalence (both positive and negative accounts) and positivity than the normative pillar (see [Figure 1](#)). Although the cognitive pillar was less addressed by the news media than the normative pillar, more arguments were linked to it.

The majority of articles in this pillar were about knowledge of the effectiveness and risks of GM food, and less about its working principles. Throughout the years, the public was informed by the media about conflicting scientific studies and research reports by various stakeholders (e.g. NGOs and governments) on the risks of GM food, mostly regarding health and the environment. From the end of 2013 onwards, the media reported mostly positive about views of GM food in regard to human health.

Another issue that appeared in this pillar was the lack of knowledge regarding GM food among the general public and politicians. In several articles, it was reported that the general public was not informed enough, despite a national debate 'Eten en genen' (Food and Genes), which was organised by the Dutch government. Additionally, various studies were conducted to analyse the knowledge of citizens regarding GM food. These studies showed that most citizens were aware of the existence of GM food, but not about its working principles.

### ***Pragmatic legitimacy***

The pragmatic pillar, encompassing paragraphs that were written from the perspective of the utility for specific stakeholder groups, was little addressed (see [Figure 2](#)). In contrast to the other pillars of legitimation, the pragmatic pillar was addressed mostly in positive way (see [Figure 1](#)). Despite the unknown risks and normative accounts, there seemed to be an agreement in the public discourse on the potential usefulness of GM food for particular groups.

In the pragmatic pillar, two main utilities of GM food for two different types of stakeholders were addressed. One utility was the reduction of pesticides and herbicides, which could be very helpful for farmers. The other utility was the possibility of growing GM food in areas where crops cannot usually be grown, mostly dry areas in developing countries. From an economic and ecological point of view, biotechnology companies stressed the utility for farmers, as GM food could reduce the use of pesticides and herbicides and ensure more effective weed control, leading to security and therefore an increase in harvests, and less damaging effects on the environment.

In 2001 the United Nations Development Program (UNDP) issued a report that stated that although the dangers should not be overlooked, food safety should not dominate the road to food security. Articles that appeared during this period addressed topics related to whether GM food can solve the food problem for developing countries, and therefore play a substantial role in poverty reduction. Again, in the period around 2008, there was a slight increase in attention, as it was emphasised again that GM food could be a solution for developing countries.

### ***Regulative legitimacy***

Although many regulations and directives with regard to GM food were created, the regulative pillar was rarely addressed in the media (see [Figure 2](#)). When writing about the regulatory process, the media mostly reported on it in a negative way (see [Figure 1](#)).

Whenever regulations and directives were discussed, the discussion often concerned the end of the existing moratorium in the EU (which was in place from 1998 to 2003), the introduction of rules concerning labelling, and restrictions on the release of GMOs into the environment. Most of these regulations were discussed at the European level. The restriction on the admission of GM food within the European borders resulted in an official complaint by the United States, Canada, and Argentina at the WTO. These complaints led to the conclusion that the EU wrongly withheld GM food from its borders between 1998 and 2003. With regard to the restrictions on the conscious release of GMOs, media reported on how member states were deemed to transpose European legislation into national legislation, and how this transposition resulted in a warning for 12 of the EU's member states, including the Netherlands, Germany, and France, for not having done that in time. Regulations concerning the labelling of GM food were even more disputed.

## Discussion and conclusion

### *Discussion*

Legitimacy is important for both the diffusion and acceptance of technological innovations. In this study, the four pillars of legitimacy, the normative, cognitive, pragmatic, and the regulative pillar, show to be a promising framework for studying legitimacy in the public discourse. The content of the media coverage on GM food could easily be linked to one of the four pillars. The dynamics of the pillars differ in terms of the sentiment, the arguments and the stakeholders mentioned. In the debate on GM food, the focus was mainly on the normative side, and mainly negative. The cognitive pillar was also addressed in a negative way, but to a lesser extent; and the regulative and pragmatic pillars were hardly addressed by the media. Whereby the pragmatic pillar was mostly mentioned in a positive way. In line with Suchman (1995), multiple pillars co-occurred per news article. The pragmatic and regulative pillar were hardly addressed on their own, nor in combination with each other. This also indicates the prominence of both the normative and cognitive pillar in the debate on GM food.

Taking a look at the dynamics of the pillars, we gained interesting insights in the legitimization process. First, we found that in the normative pillar relatively few arguments were present. This implies that emotional and irrational factors dominated this pillar, which is in line with various studies that indicate that opponents of GM food tend to address it by focusing on an emotional rhetoric. Among these opponents, NGOs are seen as the most active actors (e.g. Harvey 2007; Legge and Durant 2010). In our study, NGOs were indeed the stakeholder group that was most often mentioned in the normative pillar. Furthermore, the public debate was mostly dominated by a negative sentiment in this pillar, highlighting that GM food is a contested innovation in the public domain.

Second, after the normative pillar, the cognitive pillar was most often addressed by the media. However, in this pillar, little knowledge dissemination took place regarding explanations of the working principles of GM food. Instead, the public was confronted with contradictory results from scientific studies on the risks and benefits of GM food. In the context of radical technological innovations that have a major impact on society, such as GM food, it is extremely complex to come to an objective risk assessment. Scholars have argued that there is no such thing as a 'sound science' of sterile risk assessments or neutral scientific claims (Kearnes et al. 2006; Legge and Durant 2010). New technologies often operate in the context of wider public concerns in which the public debate is multidisciplinary in nature and has competing scientific values (Legge and Durant 2010). The lack of explanations of GM food in the cognitive pillar clarify earlier findings of Hanssen et al. (2015) and Lucht (2015) who noted that there seems to be a lack of knowledge among the general Dutch public regarding GM food.

Third, both the regulative and pragmatic pillars were hardly addressed. The pragmatic pillar was the only pillar that was addressed positively more often than negatively. This finding is in accordance with Lucht (2015), who emphasised that adopters are often characterised by pragmatic positions towards GM technologies. The positive characteristics of GM food attributed from a pragmatic point of view might indicate that this pillar offers the most potential for legitimacy. However, as

Scott (2013) emphasised, it does not suffice to create legitimacy in only one pillar, because confusion and conflict could result.

In all pillars, different types of arguments appeared. However, the perspectives from which the arguments were described, and therefore the pillar, differed. For example, an economic argument in the pragmatic pillar was about the higher income that could be gained with GM food for farmers. In the normative pillar economic arguments focused on whether it is right or wrong to implement GM food based on the argument that it might benefit the society economically. Similar differences were found in the ecological, ethical and health arguments. This finding shows that it does not suffice to evaluate legitimacy based on an analysis of arguments or events as has been done in most qualitative media analyses of innovations.

### **Limitations and suggestions for further research**

Some limitations of this study should be acknowledged. First, while this study shows the usefulness and great potential of the four pillars of legitimacy as a framework for studying public discourse, other innovations should be studied as well to obtain further proof. As GM food is a contested innovation, a substantial number of articles in the media could be found reporting on it. It would also be interesting to analyse an innovation that is less contested and determine whether all pillars are still reflected or not. Additionally, it would be interesting to apply this framework to innovations that differ in their technical features and social-political context.

Second, we studied the public discourse to analyse legitimation processes in the public domain. Various studies (e.g. Harvey 2007; Legge and Durant 2010; Tosun and Schaub 2017; Twardowsky and Malyska 2012) have pointed out that in the case of GM food the media are more influenced by opponents than proponents of GM food. Although the media reflect the public discourse, this reflection cannot be linked one-on-one to the public attitude. Nevertheless, the public discourse as portrayed by the media is important for creating the legitimacy of technological innovations (Bergek, Jacobsson, and Sandén 2008).

### **Conclusion**

Within innovation literature, legitimation is regarded as an important function of the development and implementation of technological innovations. The public sphere is one of the most important domains in which this legitimation occurs, which is both reflected and influenced by the public discourse. This study shows that the four pillars of legitimacy can be applied as a generic framework to study technological innovations in the public discourse. The framework gives us insights into the state of the pillars of legitimacy of an innovation. From a theoretical point of view, it enhances our understanding of the legitimacy and legitimation processes of different technological innovations, and it is an instrument for comparing the legitimacy of different technological innovations. From a practical point of view, it provides insights in the areas that need further attention when communicating about an innovation in the public sphere.

### **Disclosure statement**

No potential conflict of interest was reported by the authors.

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