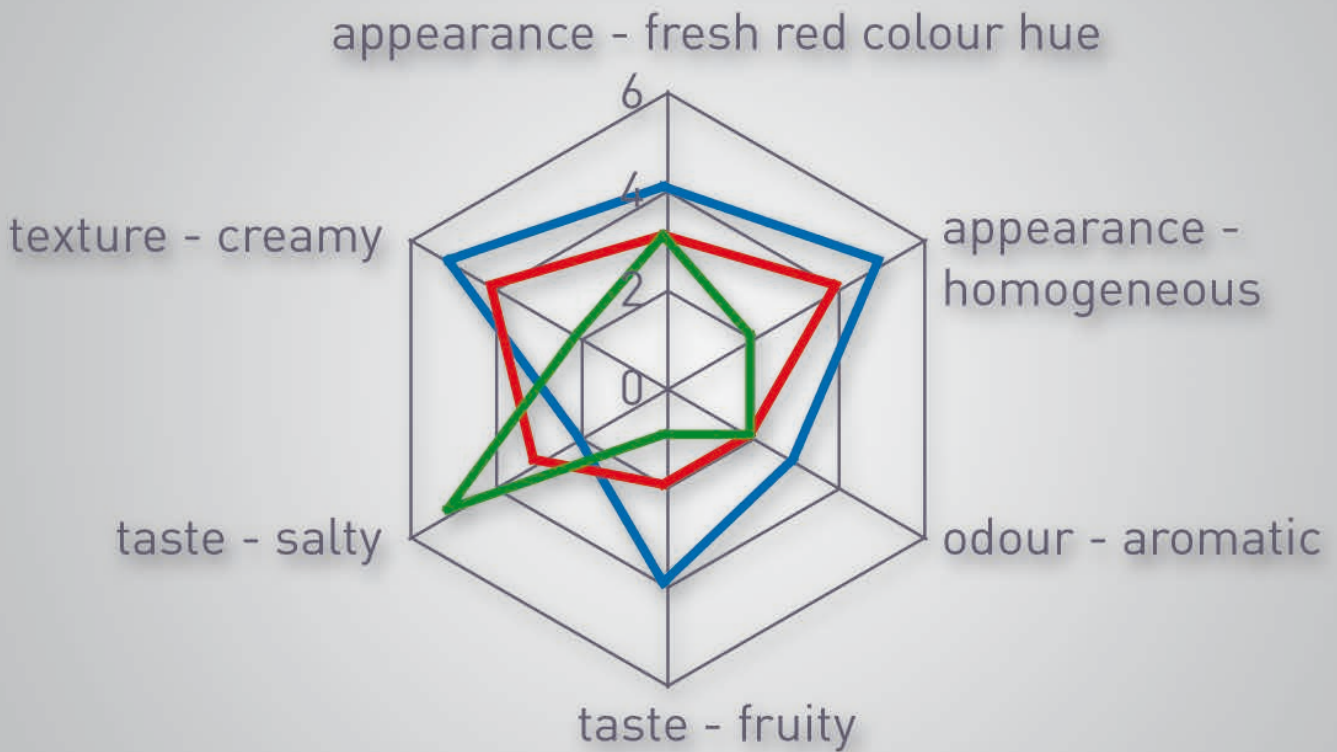


Sensory analysis: Overview of methods and areas of application

Part 4: Descriptive Tests



The analytical tests include not only the difference tests described in Parts 2 and 3 of the Worksheets, but also the descriptive methods, the descriptive sensory analyses. Descriptive tests are intended to register and measure the human perceptions and sensations during food consumption. They are used to describe products in terms of quality and quantity, in other words both to specify the product properties and reproduce their intensities. This makes it possible to draw up individual product profiles that help to characterise and distinguish products in order to derive from this what product properties lead to rejection or product acceptance among consumers. However, profile data alone are not sufficient for this. In this context they must be linked with results of hedonic (from the Greek “Hedone” = joy) tests, in other words consumer tests measuring the popularity and acceptance of products. If they are linked with chemical-physical analysis values of the products, the results of the descriptive analysis can also be used to review existing formulation components and their quantity ratios and ultimately develop these further to increase acceptance and promote sales.

Methods for descriptive analysis thus mainly form the link between market research, marketing and product development, but are also used in quality assurance, for instance when examining product profiles to monitor storage stability and minimum shelf life. Independently of the task for which descriptive methods are used, it is necessary to train the descriptive tester panel before starting the test. Only in this way can excessive subjectivity be largely ruled out and the greatest possible objectivity of results achieved. Descriptive panels are frequently made up of consumers, as these treat the products to be tested more unbiased than experts. The opportunities for panel training are described in detail in a separate Worksheet.

In the meantime a large number of descriptive sensory methods exists that all pursue more or less the same objective, but differ a little in implementation. This is because one of the underlying challenges is the enormous time-specific and hence also financial outlay.

In principle the descriptive tests consist of three phases:

The **first phase** focusses on recruiting and training testers and forming the panel. This is because for most conventional profiling methods, a comprehensive, cost-intensive and time-intensive training of testers is crucial prior to conducting the test. Alongside the prerequisite that the testers are also product users, they must be fit in sensory terms, in other words master the fundamentals of sensory analysis and be able to direct their senses specifically to product perception and characterisation. The training process of generally twelve persons each time consists mainly in alternating between group discussions and individual tests. The participants need to learn to describe in analytical terms instead of assessing hedonically. They must know and apply terms for describing attributes and be able to determine their intensities reliably. In this connection reference samples are frequently used. In addition to familiarising testers with attributes in sensory terms, they also make it possible to standardise tester perceptions as regards quality and quantity. One essential component of training is the language development. What is important here is to teach sufficient vocabulary for describing the products and learning both the substances themselves and their intensity with the help of suitable reference materials made of natural or chemical substances. Furthermore, in the training sessions the application of intensity scales as well as the specific profiling method itself are taught. The multi-stage training generally consists of between 80 and 150 hours. As well as training in the methodology, this also includes the reliability test – checking the panel for reliability.

In the **second phase** of the qualitative description the testers have to find terms to characterise the test attributes appearance, odour, taste and texture of the product and formulate these. Within the context of the **third phase**, the quantitative description, the verbal descriptions are to be backed up with intensity levels so that the qualitative description is supplemented by a quantitative statement.

The essential methods of descriptive sensory analysis are set out below. These include the consensus profile, the conventional profile and the descriptive profile test as well as the quantitative descriptive analysis (QDA[®]) and the Spectrum[™] method. Free Choice Profiling and Flash Profiling are also to be found among the profiling methods. Further important descriptive methods are the “Simple Descriptive Test” and the “Descriptive Test with integrated assessment”.

Simple Descriptive Test (DIN 10964-1996)

The **objective** of the “Simple Descriptive Test” method set out in DIN 10964 is to describe all or just individual product attributes (such as appearance, odour, taste, texture/consistence) by means of properties.

Fields of application: The “Simple Descriptive Test” can be used to characterise and describe product standards, to examine influencing product properties due to modified raw materials or changes in the formulation and for registering modified influence factors within the framework of production. This method also forms the basis for drawing up various assessment schemes that are specified in other DIN standards, such as e.g. the “Profiling Test” or the “Descriptive Test with subsequent quality assessment”. It is also used in training testers.

Implementation: The terms used to describe the product can be selected freely by the test persons or be taken from given lists. These attribute properties should generally be free from hedonic valuations, in other words represent a collection of value-free descriptive terms. If the test persons select the attributes freely, it is probable that initially both positive and negative properties will be named. According to general sensory analysis practice, these lists of terms subsequently need revising so that in the final result only value-free terms are used for further product descriptions. Details of intensity are not required. This method can be applied by both trained and untrained testers. What is important is that the test persons are able to describe their sensory perceptions accurately and comprehensively. That is why comprehensive instruction of the testers is absolutely essential. The number of test persons depends on the objective of the test. However, it should consist of at least three testers and can be carried out both individually and as a group test. The preparation and conducting of the product test are otherwise in line with the general requirements made of sensory tastings. Figure 1 shows an example of a test form for a simple descriptive test.

Profiling Tests

In Profiling Tests the DIN standard distinguishes between the “conventional profile”, the “consensus profile” and the “free choice profile”. In practice there are also further methods that deviate from each other in various parts, but in principle are comparable with the methods described below. The testers assigned for profiling tests are to be trained not only in sensory analysis, but also in product specifics regularly. Only in this way are reproducible results possible.

Conventional Profile (DIN 10967-1-1999)

Objective: With the conventional profile products are described with qualitative properties that determine the value of the product and also quantified.

Application: This method is used for instance in product development and optimising, to compare a number of different products or for monitoring within the context of product qualities fixed by product standards.

Implementation: First of all the collection of descriptive terms is necessary to draw up a conventional profile. After this the lists of terms must be structured, with similar terms being joined together and hedonic attributes eliminated. Ideally the final number of property descriptions consists of a maximum of 15 terms per test feature. After the number of terms has been appropriately reduced, in a second step the assessment of the intensity of the described properties is addressed within the framework of the individual test. The test persons assigned here must possess comprehensive sensory knowledge and be able to describe

Simple Descriptive Test			
Product: tomato juice		Date: _____	
Tester: _____			
Please describe the sensory properties of each single product sample.			
No. of product sample	Property	Sensory properties	Remarks
322	Appearance	fresh red colour hue homogeneous unnatural, artificial dull	

Fig. 1: Example of a test form for a “Simple Descriptive Test”

the product properties registered correctly. Furthermore, in the second stage they must recognise the feature properties defined again and be able to reproduce their intensity with appropriate descriptions. The minimum number of testers generally depends on the objective of the testing project, but generally consists of six persons in order to obtain a result capable of interpretation. The tester training and preparation is very extensive as described above and takes up between 80 and 150 hours. The end result is determined by adding up the individual results and then forming the arithmetical mean. The statistical evaluation of the test is oriented to the question posed and the scale taken as a basis. It is generally carried out using variants analysis, main components analysis or Procrustes analysis. The results of the conventional profile analysis can be shown in tables, or more frequently in graphs. Examples of test forms and presentations of results can be found in Figures 2, 3 and 4.

Alongside the tabular form, intensity scales in another form are also conceivable, for instance as a linear scale (see Fig. 3).

The results of profiling tests can be presented in various ways – both in the form of tables, bar diagrams, line profiles or with the frequently used polygons or as spiders web diagrams (see Fig. 4).

The conventional profiling methods also include the QDA® and Spectrum™ method originating from America. Both are protected methods that may only be used in cooperation with the respective institutes. The main difference between the two methods lies in the course of training – relatively short for QDA® and relatively long for Spectrum™. The details regarding these can be taken from the respective technical literature.

Consensus profile (DIN 10967-2-2000)

Objective: The consensus profiling method originates initially from the Flavor Profil Methode®. This too serves to describe and quantify sensory product properties.

Areas of application include the characterising of product standards, the comparison of a number of different product standards, product development and optimising, as well as registering technologically caused quality fluctuations of the product and training testers (panel training).

Implementation: As regards the selection and reduction of the attribute properties, the methodology of the consensus profiling is identical with conventional profiling. Here too the test persons all assess the same product-relevant feature properties. Furthermore, the panel used for consensus profiling is examined and trained regularly. Here too the panel training

a) Description of attributes
 Product sample: _____ Date: _____
 Tester: _____
 Please describe the presented test product according to its appearance.

Property	Sensory properties
Appearance	

b) Reduction of attributes
 Product sample: _____ Date: _____
 The attributes within the individual test protocols are collected and revised as well as reduced.

Property	Collection of Sensory properties	Final results on Sensory properties
Appearance		

c) Test protocol on single tests including intensities
 Product sample: _____ Date: _____
 Tester: _____
 Please describe the intensities of the sensory properties presented within the test product.

Intensity scale:

- 0 not recognisable
- 1 very poor recognisable (perception threshold)
- 2 poor recognisable
- 3 clearly recognisable
- 4 intensive recognisable
- 5 very intensive recognisable

Property	Sensory properties	Intensity (scale value)
Appearance	Copy of reduced list of sensory properties (Final results on sensory properties)	

Fig. 2: Examples of test forms for Profiling Tests

requires around 80 to 150 hours and in addition to general sensory analysis includes the development of a uniform language, also using reference materials, as well as training with intensity scales and learning the profiling method.

The two profiling methods differ in the way they are conducted – in consensus profiling the test persons discuss their individual findings gathered after the individual test in group discussions and come to a joint overall result. The end evaluation is thus not carried out by means of statistical methods and calculations on the basis of the individual assessments, but instead on the basis of a group discussion. After this the results are presented as in the case of conventional profiling. Here too the minimum number of testers depends on the objective. Generally, however, it should be possible to combine the assessments of at least six testers. Other sources and practical experience have shown that it is expedient to use panel sizes with an uneven number of 7 – 13 testers and to limit the number of products to be tested to around twelve samples.

When selecting testers, the focus is not only on sensory analysis skills but also on personal characteristics, for the product profile will be elaborated in the course of the group discussion so that it is important for all testers to report their own perceptions to the group and if necessary defend these and ultimately tolerate the group result. For this method a group leader or panel leader who steers and moderates the group dynamics is assigned. Furthermore, the panel leader is also tasked with taking the final decision in difficult situations and can thus be the deciding factor for a result.

Line scale

Sensory properties: pale



Fig. 3: Intensity scale in the form of a linear scale

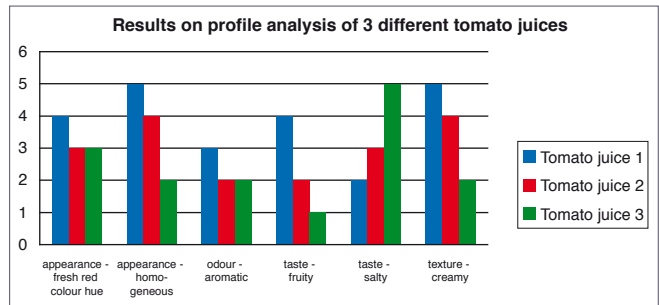
d) Presentation of results on profiling tests

Example: Tomato juice

d1) Table form

Sensory descriptors/intensities	Tomato juice 1	Tomato juice 2	Tomato juice 3
appearance - fresh red colour hue	4	3	3
appearance - homogeneous	5	4	2
odour - aromatic	3	2	2
taste - fruity	4	2	1
taste - salty	2	3	5
texture - creamy	5	4	2

d2) Bar graph



d3) Spiderweb graph

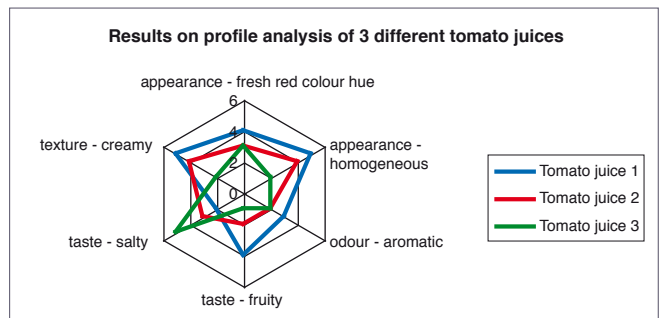


Fig. 4: Presentation of results of Profiling Tests

The criticism of this method relates above all to the testers themselves, who might be able to influence each other as a result of the group discussion at a round table so that they do not form their own assessments, but instead take over that of their neighbour. Conducting the test in individual cabins or round a test table with partition walls can help to remedy this and to register initially individual judgements before the group discussion starts.

Free Choice Profile (DIN 10967-3-2001)

Objective: The “Free Choice Profiling” method was first developed in the United Kingdom. Like other profiling methods, this method too serves to describe and quantify sensory product properties. However, by means of adjustments to the methodology, attempts are being made with the “free choice profiling” to reduce the substantial training outlay and the high time and cost inputs of the conventional testing methods.

Fields of application: The free choice method can be used to describe individual product attributes or to register all the product characteristics. Given the large number of terms that arise here, the method frequently also forms the basis for conventional profiling methods such as QDA etc.

Implementation: While conventional profiling tests require intensive panel training as described above, in which above all a common vocabulary is developed and learnt to describe products, the “free choice profiling” method does without this. In the opinion of the representatives of Free Choice Profiling, the intensive training method prevents consumer impressions being taken into consideration sufficiently.

The following sequence is characteristic for a Free Choice Profiling method:

- a) No costly training of testers is necessary. This is because untrained or only slightly trained testers are deployed. The members of the panel must be fit in concerning their senses and be capable of expressing their feelings in words. In this method it is not necessary to unify the terms. On the contrary, the testers can work with free and individual associations as well. This does away with the need for a joint selection and compaction of the descriptive terms, as each test person uses own descriptions of the attribute properties to characterise the product.
- b) The quantitative description of the attributes can take place on an individual intensity scale, in other words there is no standardisation here either.
- c) The evaluation is carried out with the help of a special, multi-variate statistical method the Generalized Procrustes Analysis (GPA), which makes it possible to derive a consensus configuration from two or more data sets.

As regards the number of testers to be deployed, it should be noted that the less trained the testers are, the more testers are needed to obtain statistically validated results. In general the number of testers lies between eight and 30 persons, but depending on the project goal it may also comprise up to 100 participants.

Flash Profiling

As already described, the disadvantage of conventional descriptive methods results from the time-intensive and cost-intensive training phase of the panels to be deployed. Cost pressure and time pressure in innovations and the ever shorter product life cycles demand faster availability of information relevant for decision-making. Nor is it possible to respond so quickly to acutely urgent questions and problems arising with conventional profiling.

The goal is to offer the industry a fast method of determining of sensory information relevant to decision-making with the help of the Flash Profiling Method.

Fields of application: Flash Profiling allows fast positioning of products in accordance with their key sensory properties or differences and thus provides a fast insight into the prevailing product conditions. The findings obtained in this way could then be intensified by using conventional profiling methods or be linked with the results of affective tests.

Implementation: As in the case of Free Choice Profiling methods, in Flash Profiling too the testers are free in the selection of the number, significance and sequence of their descriptive terms. By waiving uniform terminology it is possible to do without costly training methods. By contrast with Free Choice Profiling, all the testers receive all the samples to be tested at the same time. This results in a different testing and profiling system, in which the products can be compared with each other directly during tasting. This means that instead of the profiling that has been customary so far, in which all feature properties are worked through product by product, in the Flash Profiling Method the profiling of a feature property is described and evaluated for all products before proceeding to the next feature property (see Fig. 5).

Traditional Profiling Methods	Test sequence within Flash profiling method		
Test Product 1 - sweet Product 1 - aromatic Product 1 - bitter	Test product 1	Test product 2	Test product 3
	- sweet		

Fig. 5: Overview on the different test sequences within Profiling Tests

Flash Profiling is a very young method in the field of profile analysing. In principle it follows the three phases described at the beginning above. By contrast with the detailed training phase described here, the recruiting of testers and their examination with regard to fundamental sensory skills and their good perception and objective descriptive skills are carried out within the framework of the Flash Profiling Method. The general introductory and familiarisation phase takes at most one to two sessions. Once six to ten testers have been found, the second phase starts – the description of the feature properties, in other words finding the descriptors. The result of this consists of individual lists of the feature properties perceived by the testers with regard to the products. The panel leader then examines these lists and deletes hedonic terms. Furthermore, each tester learns how the other testers described the products and can accordingly supplement the properties still lacking in their lists. Within the context of the profiling, each tester uses his or her individual list of feature properties and supplements this with the respective intensities. As described above, the samples are not presented in sequence for profiling, but brought to the table at the same time so that the tester can test all the products at the same time and work through them feature property by feature property. Fig. 6 shows an example of a test sheet for determining the intensities with the aid of Flash Profiling. Above all consumers untrained in sensory analysis are deployed in the Flash Profiling method. What is important here is that constant test conditions are maintained, just as they prevail in sensory analysis laboratories. Otherwise the general requirements made of sensory testing such as neutralisation of the samples, maintenance of the sample sequence to maintain the sensitivity of the human senses and neutralisation of the senses in between apply. The results are valued and interpreted with the aid of a multivariate statistical method, the Generalized Procrustes Analysis (GPA), which is also used for Free Choice Profiling.

Tester: _____ Date: _____

Sensory property / attribute: sweet

|-----|

Product A

not recognisable |-----| very intensive recognisable

Product B

not recognisable |-----| very intensive recognisable

Product C

not recognisable |-----| very intensive recognisable

Product D

Fig. 6: Example test protocol on the description of intensities within Flash Profiling Method

Descriptive test with subsequent quality evaluation (DIN 10969-2001)

The objective of the “descriptive test with subsequent quality evaluation” is initially to determine the intensities of previously defined test criteria and feature properties of products and then to transfer the results into an assessment or quality statement.

Fields of application: This sensory method is thus suitable for product assessment when the raw materials used are changed or new processing technologies are applied. Furthermore, this method is also suitable for examining the minimum shelf life and the influence of packing and storage on the product quality. This method is also used in the context of cross-company product tests and quality tests.

The **implementation** of the test is generally divided into three sub-areas, in which steps 1 and 2 are largely identical with the profiling method:

1. Production of a catalogue of feature properties (qualitative profile): Here different approaches can be used. For example if a product is to be tested against an existing product standard, it might be sufficient to simply list the feature properties deviating from the standard. However, the specification of complete lists with feature descriptions is also conceivable. If completely new products are to be assessed, corresponding feature properties must be described, gathered and compressed as with the profiling method.
2. Determination of intensity of properties (quantitative profile): In individual tests the intensities of the feature properties are to be described, as when profiling tests are conducted.
3. Assessment of the products: In order to reach an assessment, the intensity descriptions of the feature properties are to be transferred into judgements. For this, before the test takes place, it is necessary both to define a weighting for the features and also for the feature properties and furthermore specify evaluation levels and devaluation levels. Here intensity limits are to be defined within which for example the devaluation level of the quality or exclusion from a test can be carried out. This can among other factors serve for quality assessments for award-winning stages, for minimum shelf life periods, or

also for product comparisons and authenticity tests, for here especially the upper and lower quality levels within which products are no longer fit for sale, fit for consumption or qualitatively acceptable are to be defined. The evaluation bases are defined and implemented by the test leader. The test leader can call in help from external persons, but under no circumstances may the testers be involved here. Here too the number of testers depends on the goal of the project.

The DLG Quality Tests for Foods and Beverages are examples of “descriptive tests with subsequent quality assessment”. The DLG test schemes which have been designed and standardised on a product-specific basis, known as the DLG 5-Point Scheme®, combine all the information relevant for the test. They comprise on the one hand the sensory test features (such as e.g. appearance, odour, taste, consistency/texture) and descriptive feature properties that describe the respective products or possible product faults (e.g. e.g. muddy, pasty, slimy, hard, rancid, rotten, bitter, blood spots, bone splinters). The evaluation of the intensities of the product faults identified are carried out with the help of a six-stage scale. After the description of the feature properties and reporting of the intensities, as well as considering the observation of defined boundary levels, the quality number can be determined. This is done within the context of a standardised, computer-assisted method on the basis of the score achieved and the weighting factors defined on a product-specific basis for the respective test attributes. The quality number forms the basis for the award stage achieved in the form of the Gold, Silver or Bronze DLG medal or indicates whether no DLG medal can be awarded due to the quality defects existing. The test results are presented within the framework of a test finding report that lists the product-specific results and the award level achieved. Panels of trained testers are deployed for the DLG quality tests. On the one hand the testers are qualified through their professional training in the field of Warenkunde and product production and they have been given sensory training by DLG and are regularly tested as regards their expert knowledge within the scope of a defined monitoring process. Further details of the sensory analysis method applied within the framework of the DLG quality tests can be found in Worksheet 2/2009 or from DLG-Verlag (www.DLG-Verlag.de).

Conclusion

Descriptive sensory analyses, i.e. the methods of descriptive sensory analysis, are considered to be the most demanding sensory methods on the grounds of their diversity and complexity. In general they represent a quantitative description of sensory product properties and are based on the sensory perception of qualified individuals. Specially trained testers are deployed for the tasks within the context of a descriptive analysis, such as identification, description and quantification of objectively perceivable sensory product properties. The goal of this method is to produce a detailed product description that can be compared with other products or be put to use in product recipes and formulations. This enables the product developer or the responsible quality assurance officer to identify the essential dimensions of a product and compare it with company standards or products from the competition. In order to be able to make statements regarding consumer acceptance, these profile data still have to be linked with further results from affective sensory analysis or hedonics (popularity test). Alongside the multiple-stage sensory analysis method, the costly training methods to qualify testers represent a major criticism of users who are driven by scarcity of time. Even though already shortened and simplified descriptive testing methods have been developed, the challenge for the future remains to build on these experiences in order to achieve reliable and informative test results as soon as possible.

Authors:

Bianca Schneider, Sophia Nucke, DLG e.V., Frankfurt/M.

The detailed list of used literature is available on request under: sensorik@DLG.org.



DLG e.V.

Competence Center Food

Eschborner Landstr. 122 · 60489 Frankfurt am Main

Tel. +49 69 24788-311 · Fax +49 69 24788-8311

FachzentrumLM@DLG.org · www.DLG.org

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