Skill Gaps in the Dairy Manufacturing sector in Europe

- a data analysis

Foreningen af mejeri ledere og funktionærer

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AEDIL

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Executive Summary

During the winter and autumn of 2018, a consortium composed of 11 dairy sector partners covering 14 European countries interviewed 117 dairy plants, 56 educational institutions (VET-level, college--level and university degree), and 65 ex-students. The governance body of this EU Erasmus+ funded Sector Skills Alliances project is Association of European Dairy Industry Learning (AEDIL), which has 15 member countries. The objective of the project is to identify i) the demand for skills from the dairy industry now and in 5 years' time, and ii) the actual skills delivery from the educational institutions, and collectively ascertain the major skill gaps between the two. This report provides an overview of the main findings and gaps, as well as an analysis of the data contextualized into country specific settings.

The name of the project is *Mapping Skills Needs and Supply in the Dairy sector*, and the ultimate aim is to recommend actions on how to close the identified skill gaps to the dairy sector- educational institutions in the 14 countries specifically, but also at an overall level to other countries that could benefit from the results and recommendations.

The results across the 14 countries identified seven major clusters of explicit requirements for upscaling of skills or need for action *(see Figure 1)*:

1. *Audit*
2. *Dairy skills*
3. *Digital skills*
4. *Green skills*
5. *Food Safety skills*
6. *Management (business understanding)*
7. *Recruitment*

The most significant need which was identified was recruitment with a percentage near to 85 % by the European dairy industry (small, medium and large dairies). This was followed by dairy skill needs with approximately 75 % as second rank, which is significant as there is a tendency in many countries to turn dairy education into general food education with the possibility of specializing in dairy. Other high-ranking skills in demand from the dairy industry are digital skills, business understanding and food safety skills. All with more than 60 % rating. Also, green skills were identified as a greater concern with around 50 % of all dairy plants claiming this to be a major concern. Audit was identified as a need of only minor concern, which must be understood as audit being well covered and integrated at the dairies.

Dairy education is mainly offered in Europe, in colleges that offer vocational and practical training, and in universities with undergraduate, graduate and doctoral programmes. In the survey, curriculum content was investigated at these educational institutions. As a general trend the research found that all dairy educational institutions perform very well on the core subject: dairy (products, science and processing), whereas teaching in digital skills and green skills related to the dairy industry is only taught at an average of 30 %. Furthermore, business understanding is rarely taught at the schools, as it is assumed to be an area that graduates will learn once they are employed in the industry.

In addition to the research activities in the project, work-based learning (WBL) which is defined by CEDEFOP as one of the most important training strategies in order to improve the quality of vocational education based on practice, has been investigated throughout the European countries that participated and the 10 best practices have been compiled and will serve as inspiration for the European dairy manufacturing sector and dairy educational institutions.

Introduction

For the provision and training of skilled labour force for the EU dairy manufacturing industry, if no measures are taken; it is inevitable to face important sectoral problems in the next five years. When the current situation of the EU dairy industry is evaluated with projection five years ahead; in terms of the provision of skilled workforce, some important challenges were identified.

First and foremost, recruitment was identified as one of the overall concerns of most dairy plants interviewed. Even when 'recruitment' as such was not part of the survey, and hence no specific questions were asked to this area, it was raised as a *major future challenge*.

Dairy plants find it difficult not only to attract people with the right qualifications, but also to attract abundant number of employees. Furthermore, the dairy plants face challenges retaining qualified employees - some due to natural causes as retirement - but others because of better working conditions and/or better salaries in other sectors, as for example the ingredients- or pharmaceutical industries. Many young people have an ambition of a balanced work-family life, which does not fit well with traditional positions at dairy manufacturing plants that work with 12-hours shifts for example.

The dairy sector has more often than not, an old-fashioned image, which makes it difficult to attract enough students to the different levels of dairy education. When thinking of dairy manufacturing, many people think of hard physical work turning 50-kilo cheeses around and skimming milk manually. The image of fully automated dairies with advanced technology, robots, a green and sustainable agenda as well as innovative - and value-based - products is not very widespread.

Secondly, the automated modern dairy requires employees with digital skills. Digital skills, however, do not stand alone, employees must know how to process milk using modern equipment and combine milk processing information with digital information and big data.

Thirdly, environmental challenges have come to stay, hence the green agenda will gain even more space in the future. Whereas the dairy sector is highly important in the effort of tackling global challenges such as malnutrition and food security, the processing of the milk also generates significant waste, and hence most dairy plants work hard to adapt all elements of the processing and packaging to more environmentally friendly processes. This requires highly qualified employees who both understand the processing of milk as well as the sustainable management of natural resources and waste management.

Finally, Food safety and business understanding are important to the dairy sector. Among European research areas, food safety is at the forefront because of the increasing microbiological and chemical risks and increasing standards for hygiene and food safety. As regards business understanding this topic is dealt with more broadly. It is both the understanding of the whole supply chain (from cow to consumer), and how this affects the milk processing, as well as cooperate understanding of the specific dairy company, an employee works for.

General trends across Europe

Demands from the Industry

By size

In figure 1 are shown the major industry demands agglomerated across entire Europe (n = 117) and split by production size (n_small = 39, n_medium = 32 and n_large = 46)

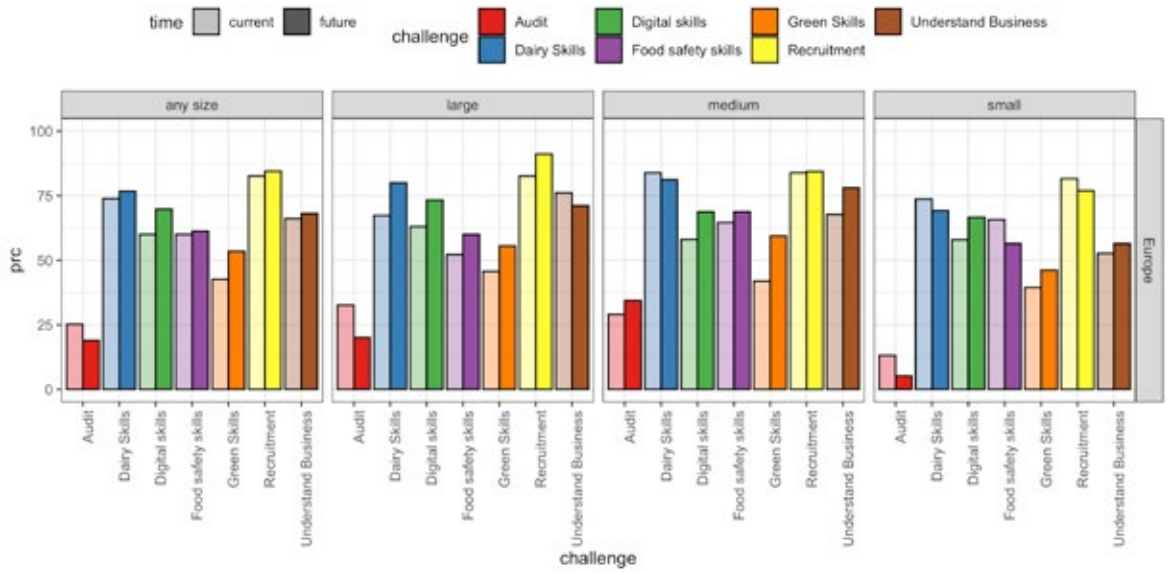

Figure 1. Comparison of dairy skill needs at present (light colored) and future (dark colored) based on the plant size (small < 50 production employees (PE), medium: between 50 and 150 PE and large: > 150 PE)

One of the major concerns across all European countries is recruitment *(yellow bar)* with 85 percent of the industries claiming this as a major challenge. For the larger companies the concern is a little higher than for small and medium companies. The difference between current demand and the demand expected in 5-years' time is not significant. This is the same case with all other major challenges: even when a slight difference appears, it is not above five percent.

The core of the dairy manufacturing industry: dairy skills *(blue)* also ranges high with an average of 75 percent demand from companies of any size. Furthermore, digital skills are in high demand from the dairy manufacturing industry with an average of 72 percent in 5-years' time.

By product type

Figure 2 shows the major demands agglomerated across entire Europe (n = 117) and split by production type (n_chesse = 85, n_milk = 60, n_butter = 53, n_fermentedmilk = 54, n_icecream = 9, n_spec = 30 and n_NA = 3). Be aware, that one dairy can produce several products and are hence present in several categories.

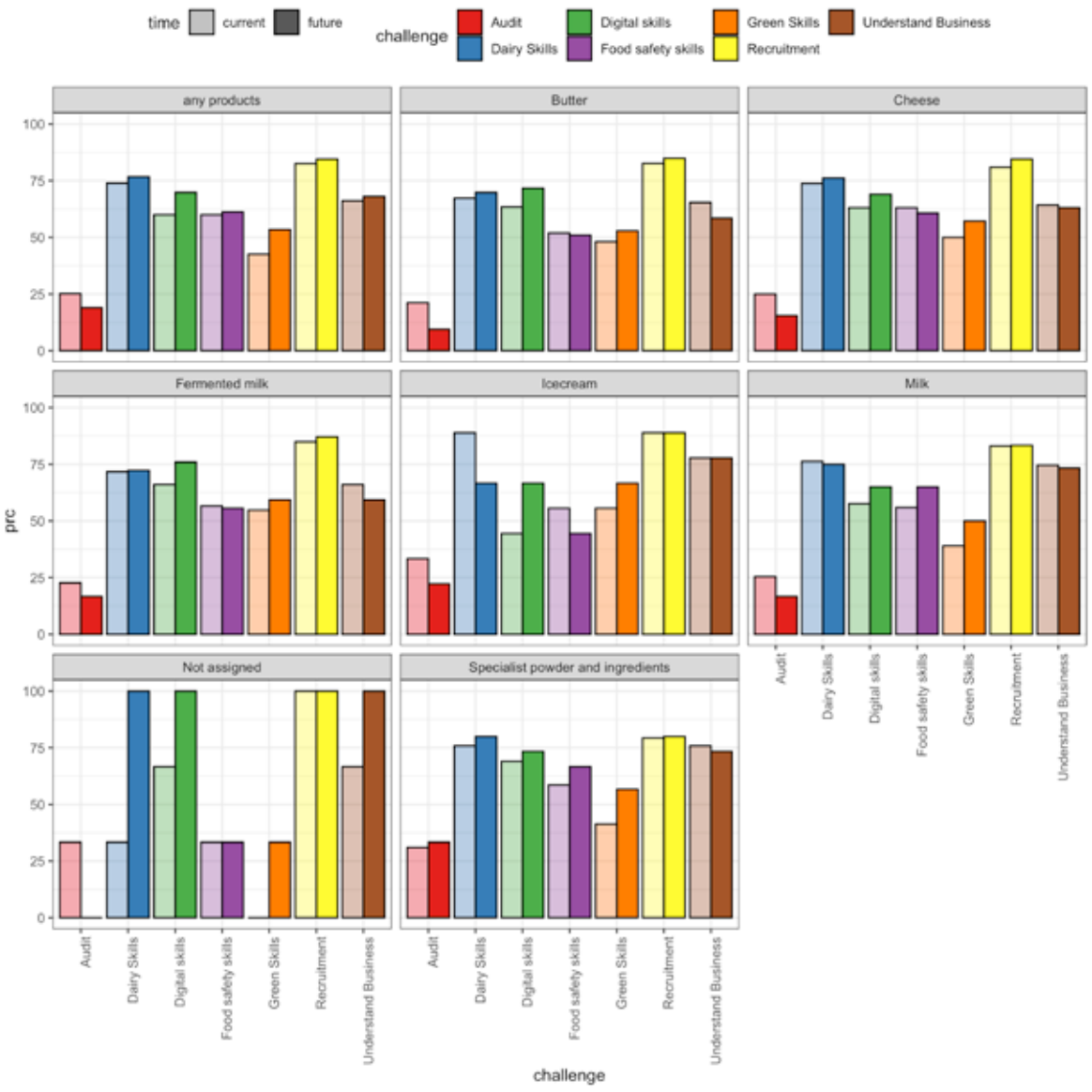

Figure 2. Comparison of dairy skill needs at present (light colored) and future (dark colored) based on production type (n_cheese = 85, n_milk = 60, n_butter = 53, n_fermented milk = 54, n_ice cream = 9, n_spec = 30 and n_NA = 3).

The above shows that there is no unique challenge pattern related to product type. Merely all productions claim the same challenges at the same rate.

Educational output

Figure 3 shows the overall percentage of topics provided by educational institutions across the 55 participating European educational institutions.The figures show global topics with sub-categories. The vertical line shows the average standard.

On all dairy subjects (teaching in dairy products, in dairy processing and in dairy science) the score is quite high. On average between 70 and 85 percent. There are, however, subcategories that are not very well covered, such as powder milk, organic dairy products and baby formulation.

On process control the score is quite low. An average of 30 percent, where software development, robotics and programme logic control scores below this average. As a global skill, process control is considered digital skills.

The lowest average score is to be found on Lean Skills, which is defined as Lean Behaviours, Basic Lean Tools, Continuous improvement among others. This topic scores only 25 percent.

Also hitting the low end is Dairy Material Science with an average of only 30 percent.

Green skills also show an average of 30 percent. The subcategories warry significantly as the subcategory *Technologies within the green area* is way above average with almost 90 percent, whereas Risk Management and business models with a green focus score only 26 percent.

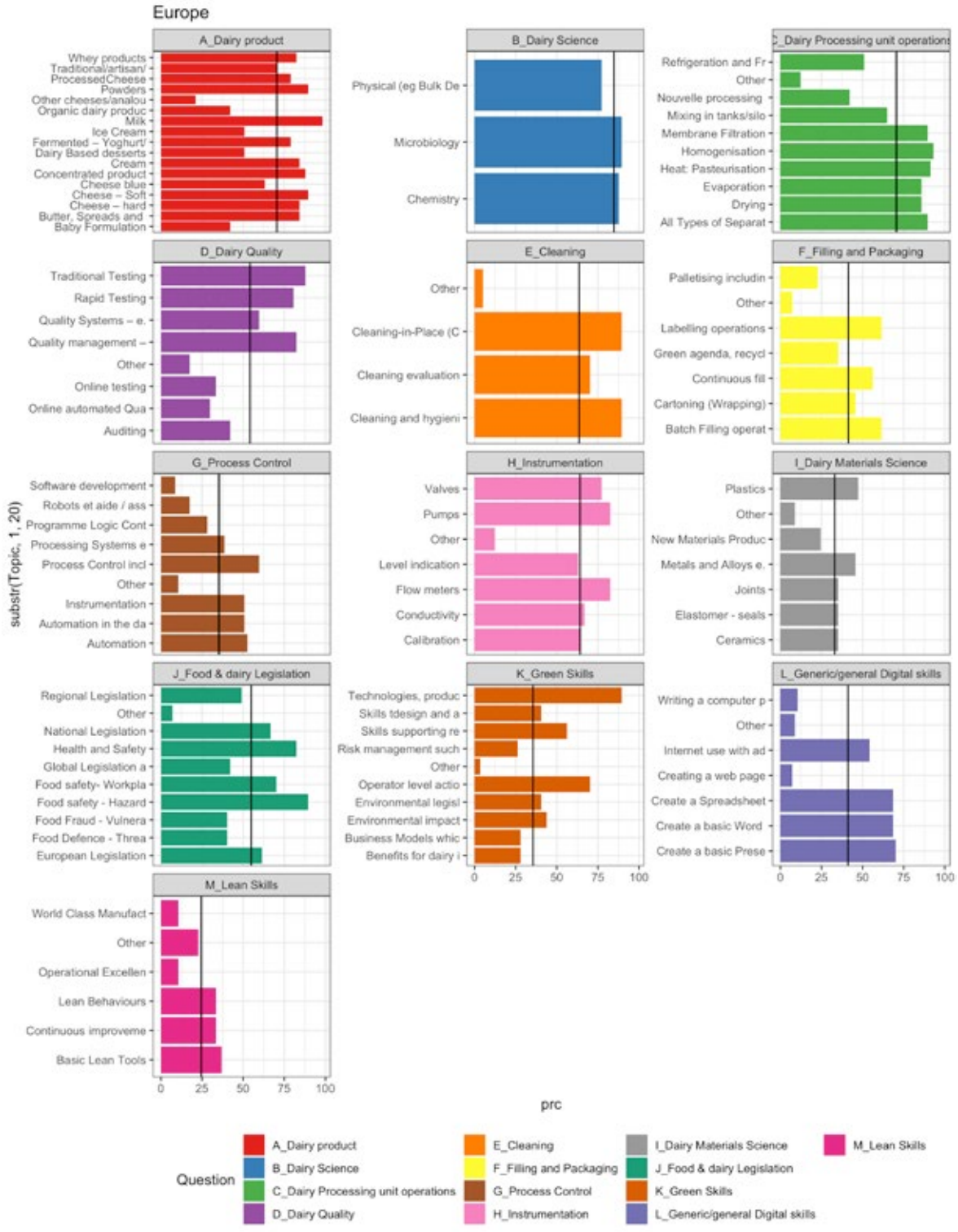

Figure 3. Overall percentage of topics provided by educational institutions (55 educational institutions in Europe).

Gaps

The gaps are specified as major gaps reflecting overall trends as well as detailed gaps reflecting more specific needs.

Figure 4 shows the overall gaps agglomerated across entire Europe, divided on production size and current and future needs respectively.

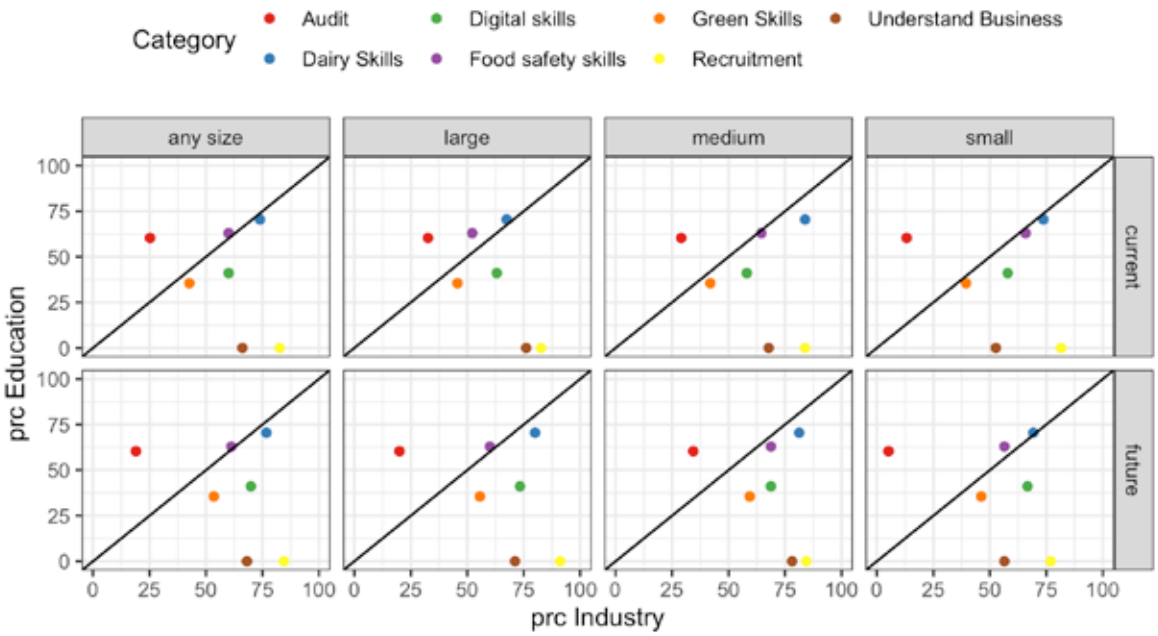

Figure 4. Comparison of skill needs (current and future) claimed by the industry(x-axis)with provision of teaching in the subjects as indicated by the educational institutions(y-axis). The purple and blue are Food Safety and Dairy Skills and show that there is no noticeable gap between the two.Industry categories are based on the plant size (small < 50 production employees (PE), medium: between 50 and 150 PE and large: > 150 PE).

In general, the largest gap is related to recruitment, which is important for more than 75% of the dairies. Recruitment was not a part of the educational survey, and hence is reported as a topic not provided. Additionally, Business Understanding is reported being important, while not being widely provided from the educational institutions.

For more topic-specific gaps Figure 5 reflects those.

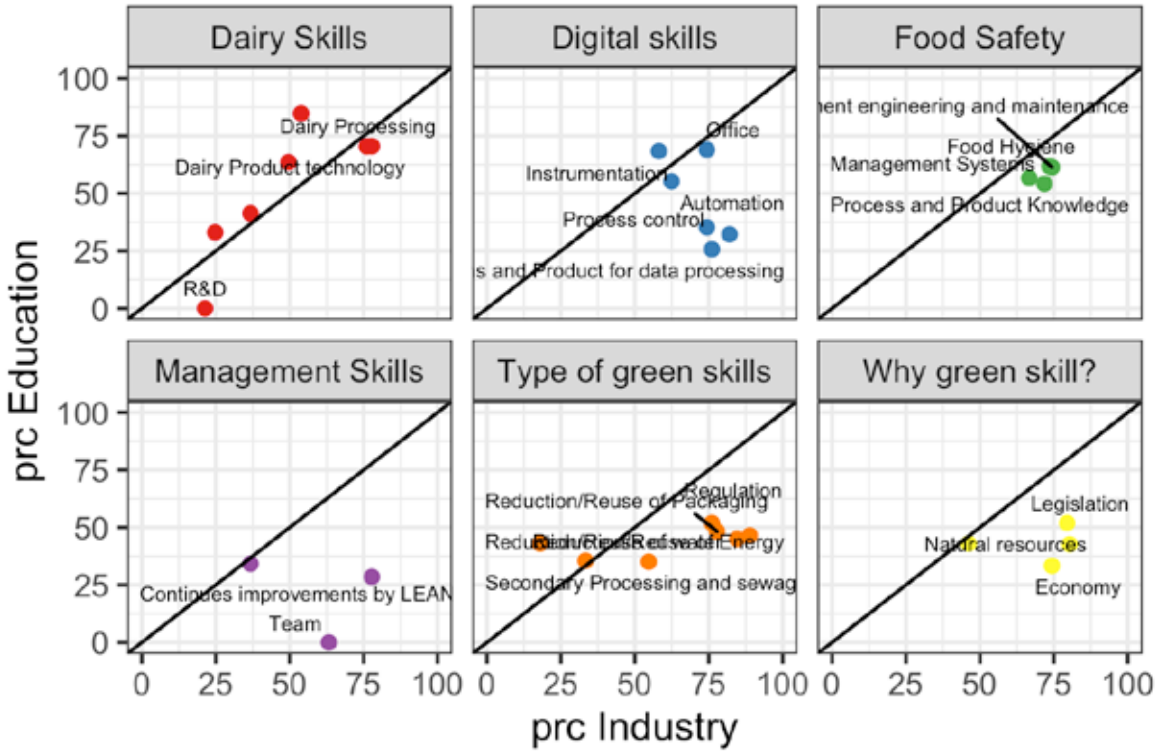

Figure 5. Comparison of specific skill needs claimed by the industry(x-axis)with provision of teaching in the subjects as indicated by the educational institutions(y-axis). The green and red are Food Safety and Dairy Skills and show that there is no noticeable gap between the two.

The top five most important gaps are team management skills, green skills related to reduction/reuse of packaging and digital skills related to; spreadsheet handling, system applications and automation.

Divided out on the individual product types shows in general agreement between needs irrespectively of product categories, that is: the overall results on needs and supply complies well with the individual product categories.

Green Skills

Figure 6 shows the specific gaps between industry needs and educational output related to green skills.

In general, *reduction/reuse of water, energy and packaging* is important and not sufficiently provided. In this regard the focus is on all ends: reduction in loss of all waste streams, reuse of waste water in production, CO_2-reduction, cost efficiency and green business models linked together, green optimization in packaging and the paperless dairy (which is also linked to the digital arena).
For country specific details, see the individual country-sections.

Furthermore, 'legislation' is in high demand. This includes environmental policies (cooperate), and regulation (national and the EU) as ISO 14000, whereas the educational institutions do not sufficiently cover these needs. Also, secondary processing appears to be in high demand by the dairy manufacturing industry, whereas only France, Finland and Ireland have good educational coverage of these topics.

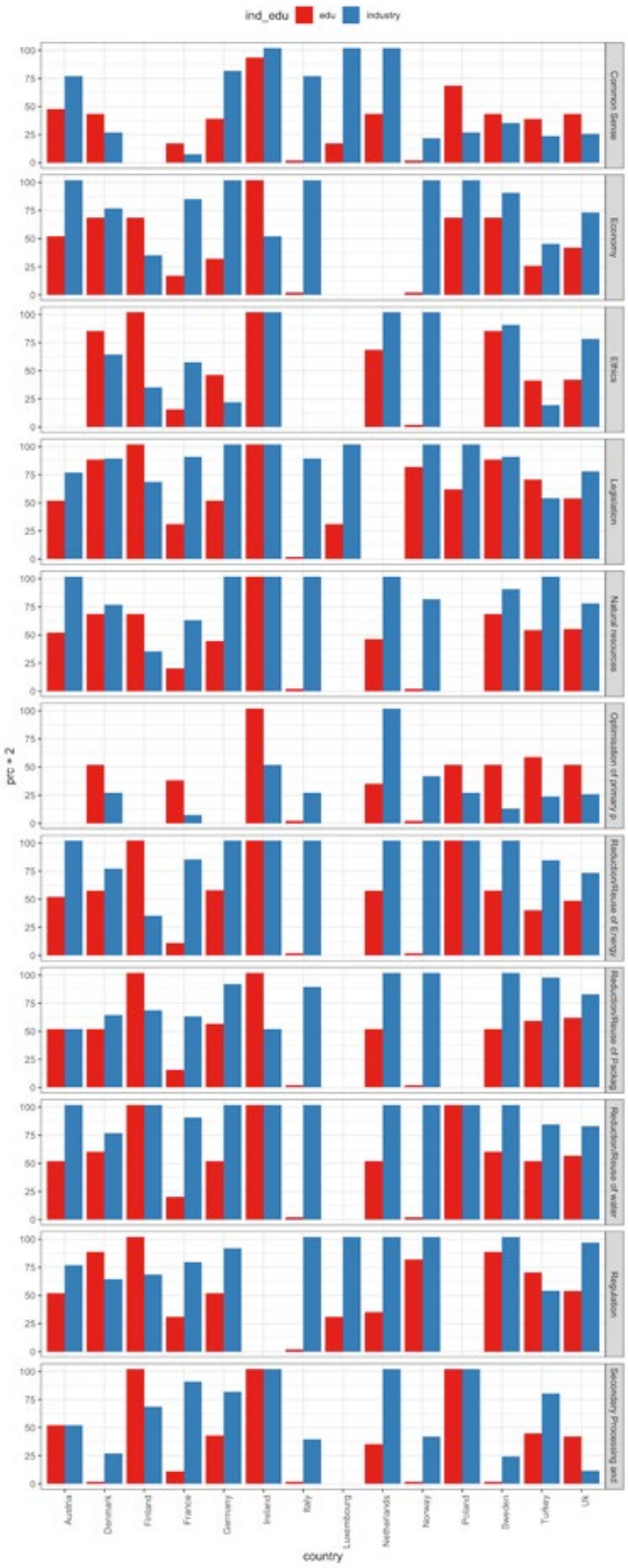

Figure 6. Green skill needs indicated by the industry (blue), compared to the delivery on the same skills at the educational institutions (red).

Digital Skills

Figure 7 shows the specific gaps between industry needs and educational output related to digital skills

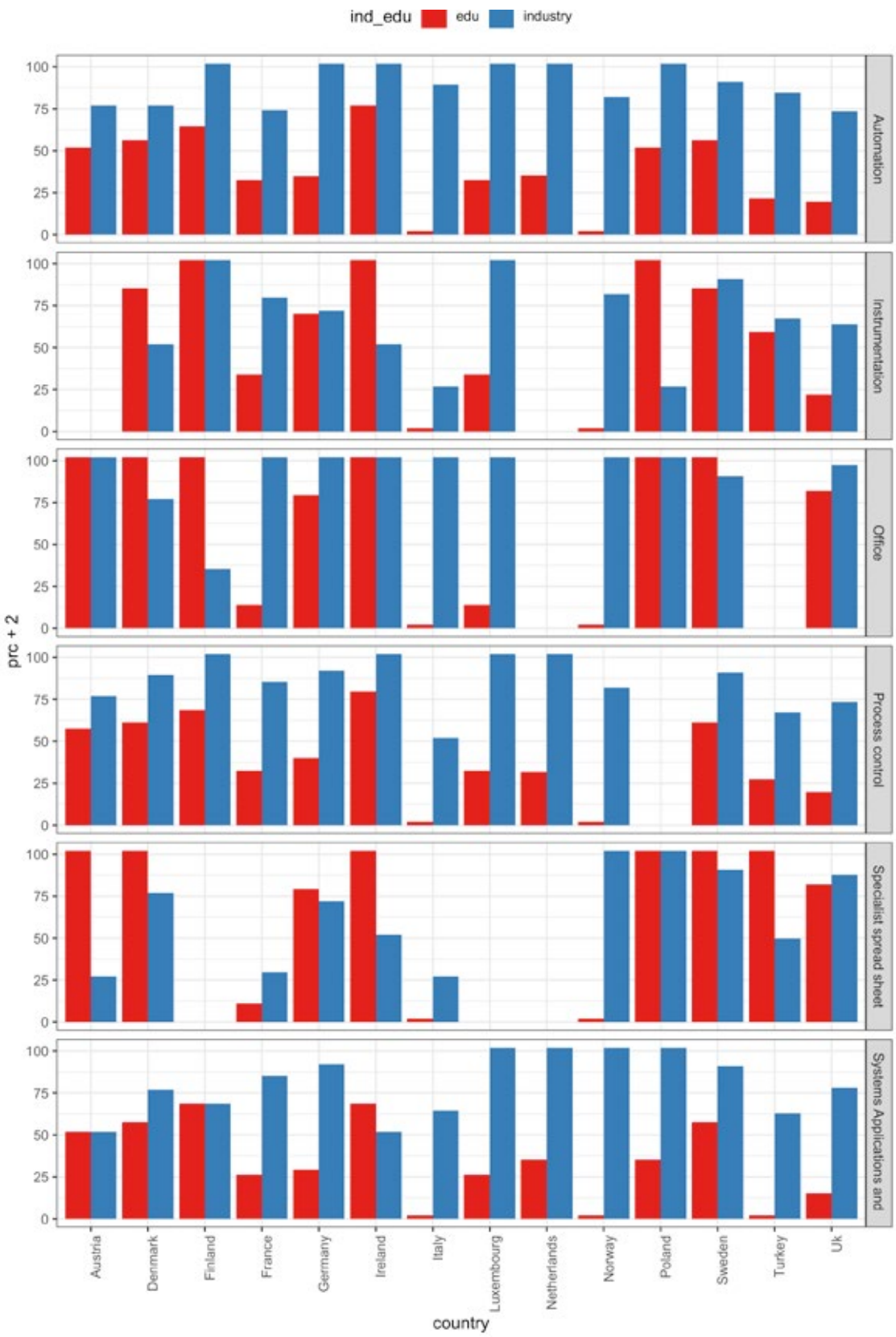

Figure 7. Digital skill needs indicated by the industry (blue), compared to the delivery on the same skills at the educational institutions (red).

Process control and automation is important, and a gap between educational output and industry needs is observed. For country specific details, see the individual country-sections.

In general, in regard to all the sub-categories of digital skills, major gaps are observed.

Data material

Three sources of data used for mapping demands by industry and educational output, namely: 1) Guided interviews at the production sites, 2) educational surveys completed by educational institutions and 3) educational surveys completed by ex-students.

Guided interviews

Guided interviews are performed face to face at the production site by a project researcher one for each country, leading to a total of 117 interviews performed by 16 persons. These interviews follow a structured guide covering a range of topics related to both current and future demands. Additionally, there are open categories allowing for topics which are not predefined. This is why we have a category called ‘understand business’, which is not directly matched with the educational surveys. The same goes for ‚recruitment’. Recruitment turned out to be of major concern to almost all of the interviewees in this research, which is really remarkable since no questions were directed in this direction.

Educational Surveys

The educational surveys were completed by the educational institution together with a project researcher in order to avoid question ambiguity. The survey covers 13 overall topics with a sub-partitioning of each overall topic into a total of 96 questions. For each question, the answer yes/no was provided indicating whether the topic is covered in theory and/or practical during the education, and further the possibility to indicate the total amount of hours of the total program, that is allocated. As the hours were not uniformly indicated in all the surveys, we were not able to take them into account in the graphs, which merely show whether or not the educational institutions teach certain topic.

In the graphs the educational inputs are counted for as an average per country, regardless of whether we are talking universities or VET’s. An example would be if three educational institutions have been asked about seven topics related to green skills. The total count would be 3 times 7. If two Educational Institutions confirm to be teaching four of the topics, and the third one does not teach any, then the graph will show 38% (8/21).

Ex-students educational surveys and validation

The ex-student educational surveys are surveys completed by former students from the involved educational institutions together with a project researcher in order to avoid question ambiguity. The ex-students have graduated within the last 1 to 3 years. The surveys cover the same overall- and sub-topics as the educational surveys. These surveys were made to validate the answers given by the educational institutions. Furthermore, valuable information came out of these interviews, as the ex-students had very clear ideas of what is requested of them in the industry, compared to what they were taught at the dairy school.

Data processing

The current and future demands and needs provided by structured interviews from production companies were processed via the following pipeline. First an analysis group consisting of four persons from which three had been involved in completing the interviews, interpreted the interviews in order to establish topics appearing in the interviews. These were used to construct a survey covering these topics and naturally partitioned and structured in accordance with the interviews. Secondly, all interviews were quantified manually completing one survey per production site for a quantitative analysis. Thirdly, based on the quantitative findings, a qualitative interpretation was performed specifically referencing the original narrative behind the demands and needs as provided in the interviews.

Data analysis

The quantitative data analysis was performed descriptively assigning frequencies of demands, needs and educational output for each topic. The data was aggregated to emphasize trends across Europe, and was further partitioned by country, by production type (cheese, powder, butter, milk, fermented products, ice-cream)and by production size (small: < 50, medium: 50 - 150 and large: > 150 - number of production employees).

The qualitative data analysis has been performed at national level to ensure the data are read into the right contexts and the interpretation adjusted accordingly.

For a full view of raw data, please visit: **dairysectorskills.com**

Analysis by Country

Germany

Vocational training in the Federal Republic of Germany is provided on the job and in vocational schools. This is referred to as the dual training system and is regulated by law. Cooperation partners in this dual system are the training companies offering on-the-job-training and vocational schools offering the respective specialized classes.

Company-based training can be complemented by inter-company training. There are no legal requirements ruling the duration and contents of the inter-company training, respective guidelines are developed in cooperation with the business sector.

In Germany, training in all state-recognized training occupations is based on statutory vocational training regulations in conjunction with the respective training curricula for company-based training. These regulations must be implemented equally in all federal states (the 'Länder').

There is a national framework curriculum for education in vocational schools which serves as a guideline for the federal states, but which does not need to be implemented in detail.

Dual training usually lasts three years, high-school graduates and individuals who already have a generally recognized vocational qualification may reduce the training period to up to two years.

There are two state-regulated training professions for occupational activities in dairies and laboratories, which are:

- *Milk technologist*
- *Dairy laboratory assistant*

For both professions, state-regulated training opportunities are provided such as:

- *Dairy Master*
- *Dairy Laboratory Master*
- *State-certified Dairy and Laboratory Technician*

In training programmes which lead to the title of Master, merely the type and content of the exam are laid down in a government regulation. There is no curriculum which helps to prepare the candidates for the exam and participation in preparation courses is not mandatory. Before completing the training as a dairy technician, a specialized school ("Fachschule") must have been attended. Only the federal state of Bavaria offers this possibility and the respective regulations.

Higher education in dairy science and technology is offered at three locations in Germany. In one case, a dual-studies program is possible, which is a combination of higher education and training at companies in the dairy industry. Curriculum and examination contents are laid down by the respective higher education institutions and are approved by the relevant federal states. There are no national legal guidelines for these curriculum contents. Of course, other study opportunities are also possible, for example in the areas of food technology and packaging.

Deutsche Molkerei Akademie

Traditionally, training of employees of the production area of dairies was carried out by state institutions or, in some cases, by dairy associations. Despite significant efforts, however, they were not able to meet the growing demand and therefore the companies were dissatisfied with the situation. In order to close this gap, the Zentralverband Deutscher Milchwirtschaftler e.V. (ZDM) and the Milchindustrieverband e.V. (MIV) founded the Deutsche Molkerei Akademie (DMA) two years ago. The Deutsche Molkerei Akademie has very successfully started to develop and conduct advanced training courses.

The trainees and employees at the dairies are paid according to collective agreements negotiated between trade unions and employers. There are different collective agreements in the dairies, ranging from company wage agreements ("Haustarifverträge") and collective agreements for the dairy industry up to collective agreements for cooperative enterprises.

The contents of training and examination regulations for obtaining the title of Master are also being developed by the social partners (trade unions and employers' associations) by consensus and then adopted by the State.

The so-called 'relevant authorities' in the respective federal states are responsible for the registration of training contracts, monitoring of training and conduction of the vocational and Master's examinations. In Germany, the tasks of the relevant authorities are regulated by the vocational training act.

Conduction of the surveys

Three interviewers interviewed 13 dairies, of which 10 were included in the evaluation. In this regard, it should be noted that despite the different sizes (six large, one medium-sized and three small dairies), structures and product ranges of the companies, partly identical answers were given as to the existing gaps and future challenges.

In regard to the training institutions, six dairy schools and three higher education institutions with a total of 22 vocational education and training courses were interviewed. Each of these training institutions has a pilot dairy plant or a technical centre. Additionally, 14 former students were interviewed.

Demands from the Industry

Geographically, the large and efficient dairies in Germany are located in agricultural areas with a low population. Dairies are rarely located in or near big and attractive cities. Against this background, personnel recruitment was indicated as being the greatest need for the moment by 100% of the interviewed dairies. This field of action, which was not underlaid with additional specific questions in the questionnaire, can again be subdivided into the following areas:

1. *To find and retain qualified employees*
2. *To qualify lateral entrants*
3. *To retain expert knowledge (also from older employees) within the company*

Next, with 90%, comes the need for the employees in the dairies to understand the milk market, which in the meantime has become a world market, and the complex processes from milk production and ensuring long-term supply of raw materials to milk processing and marketing, so that the employees can identify themselves with the employer.

With 70%, the next priority indicated by the respondent companies is the need for skills related to milk processing and with 60% the need for skills relating to digitization.

The need for skills regarding food safety requirements ranges at 30% and the need for skills regarding the conduct of audits ranges at 20% and both are thus at the lower end of the scale.

The fact that “green skills” range at 0% in the overall evaluation of the survey will be presented separately in one of the following sections.

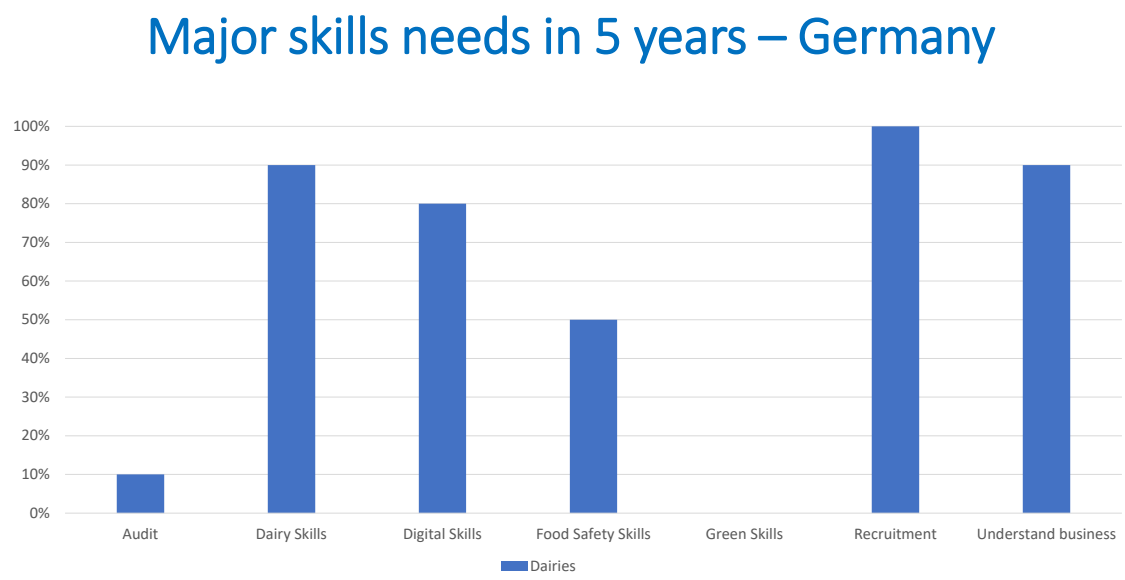

Figure 8. Major skill needs in 5 years in Germany based on the 7 categories which scored most need overall

Dairy industry – future aspects

Concentration (fewer dairy plants) and specialization processes will continue. With automation progressing, digitization will advance in the dairies, too. This will increase demands to the employees and skilled workers as well as to the dairies. Due to the increasing complexity and specialization, more experts will be needed in the large dairies. Therefore, regarding the future challenges (most important skills), employee recruitment is, with 100%, the main topic.

Next, with 90%, understanding the dairy sector (business understanding) is also believed to be a significant need. Dairy skills are estimated to be essential also in the future and therefore scores at 90%. The value of digital and specific food safety skills and competencies will continue to increase. Skills which ensure a safe food production are basically provided through education and business practice.

Skills for undertaking audits seem to be available in most of the dairies. The 10% need is due to smaller enterprises with a lower number of employees.

Training and needs of the dairies

The theoretical specific dairy and food safety knowledge is imparted well by German schools and higher educational institutions (all values more than 50%).

However, the current equipment of the pilot plants or technical centres does not meet the rapidly changing requirements of the dairy business. In addition, the relevant personnel resources are currently insufficient and will become an even bigger problem within the next five years due to the demographic development. There are still some gaps regarding cooperation between schools and industry (e.g. the audit issue). This cooperation is not yet sufficiently developed, especially regarding the issue of audits (food safety, environment), as teachers and instructors do not have the relevant practical audit experience.

Gaps

By other high-ranking topics

The dairies surveyed believe that team skills / team management skills and management skills (lean) are of vital importance. As regards education, a 100% gap regarding team management skills can be stated (see figure below). Whereas legal requirements regarding employee management are met by the schools within the scope of preparatory courses for master and technician qualifications, they are not enough. Company instructors normally have too little time for training team management skills. For company teambuilding, the instructors play a key role in delivering the skills needed for team management.

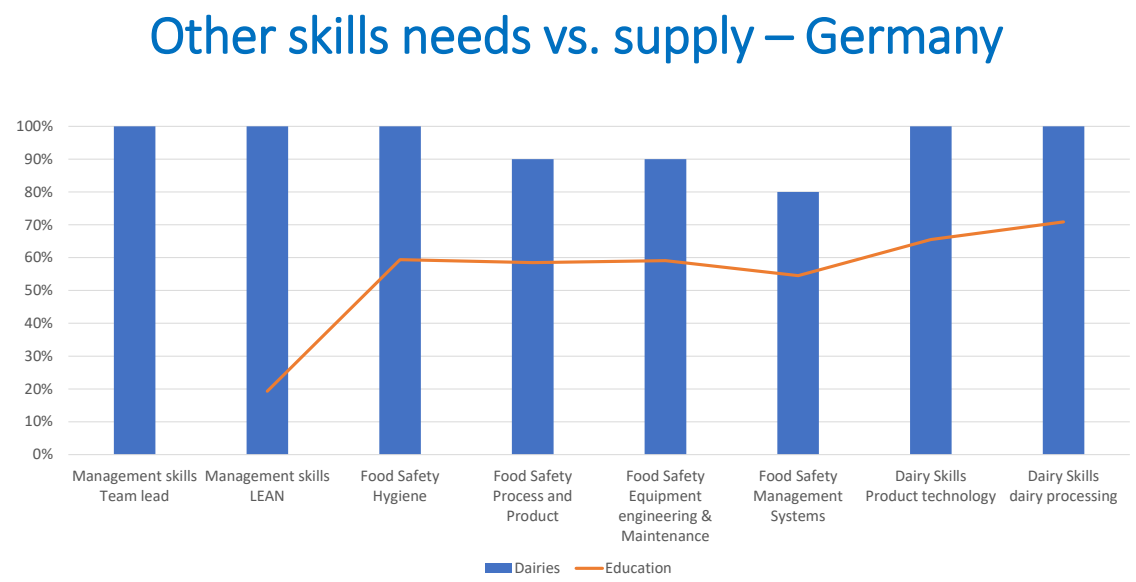

Figure 9. Other major skill needs vs. supply in Germany. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Germany (orange line).

Green Skills

Even though the generic term of the so-called “green skills” was not named explicitly within the open survey in connection with the issues relevant for the future *(see figure 8)*, the respondents went into details of the individual topics. With a score of 100%, especially the topics of reducing water and energy were considered as relevant for the future by the industry *(see figure 10)*. This is primarily due to the growing environmental awareness but increasing costs for energy and fresh water also play a role. Additionally, national and international legislation (especially with regard to climate and energy savings targets) play a crucial role.

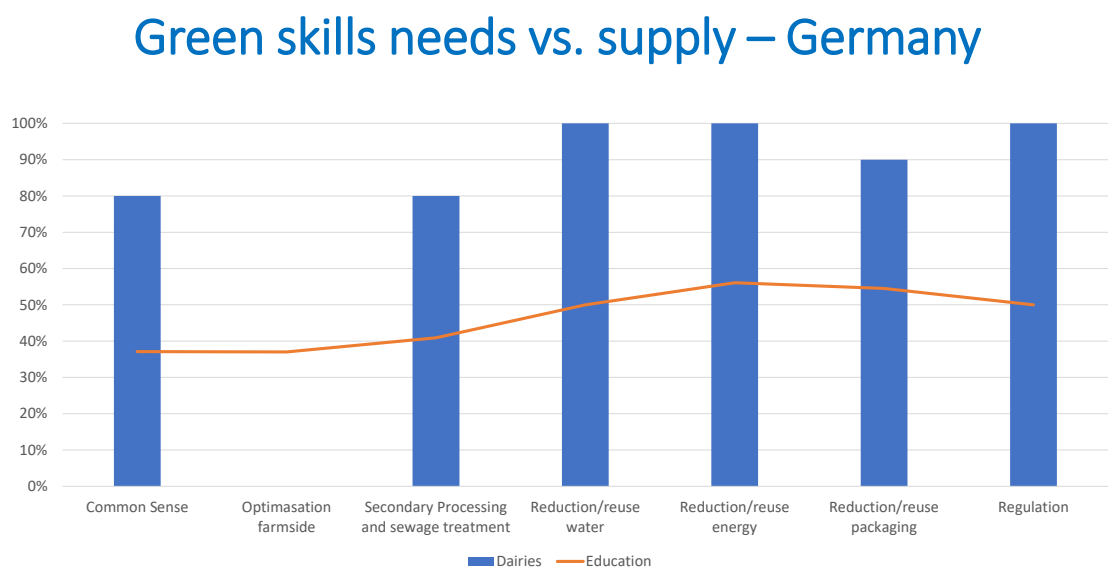

Figure 10. Green skill needs vs. supply in Germany. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Germany (orange line).

In most of the companies, there is potential for energy-savings in many production areas. These refer to: pasteurization, evaporation, drying, building temperature control, cooling, electric motors and pumps, compressed air and lighting. Energy-efficient and water-saving milk processing requires generic practical skills, a basic knowledge of environmental legislation indicated by 100% of the respondents, *(see figure 10)*, and especially a sensitization of the employees for environmental issues.

In view of the public discussion concerning the reduction of plastic residues in the environment it seems obvious that the industrial companies interviewed also considered the issue of packaging (reduction and especially reuse of packaging material) as relevant for the future (indicated by 90% of the respondents).

When comparing the response from the dairy industry to the stated teaching in the above-mentioned environmental areas by the dairy schools, a gap between 50 and 60 % is observed *(see figure 10)*.

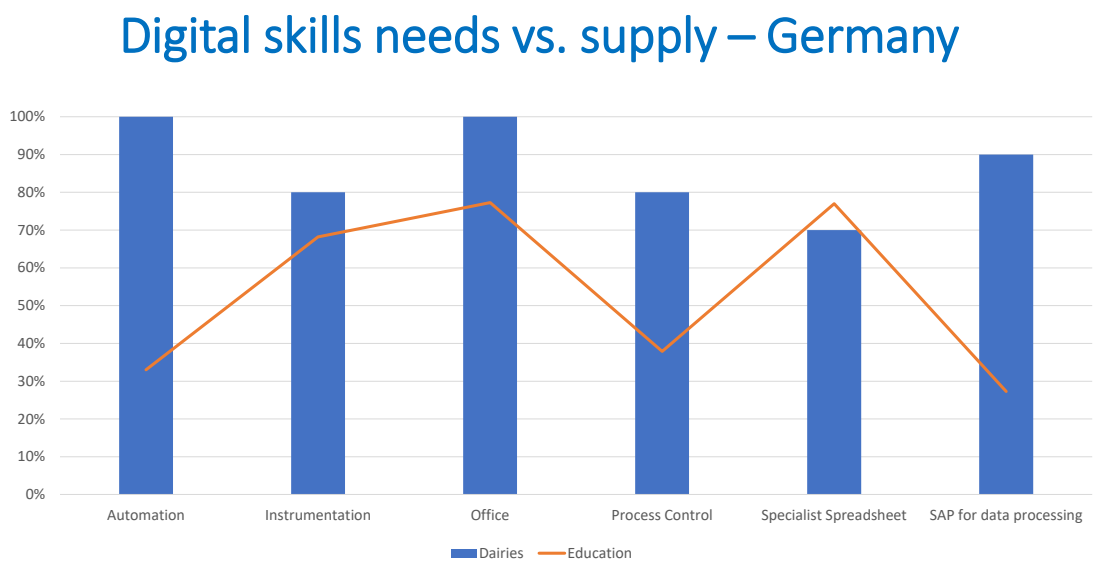

Figure 11. Digital skill needs vs. supply in Germany. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Germany (orange line).

Digital Skills

Digitization and the internet are changing the production processes and supply chains throughout the entire economy and this is also true for the dairy industry. By connecting process-equipment and production streams, sensors will provide data collection in real time, and facilitate a deeper process understanding, and automated procedures for production optimization. This will eventually lead to increased turnover and save resources.

The companies and schools surveyed believe that the greatest gaps (60 to 70%) result from issues concerning automatization and handling of production data (especially in connection with SAP).

While the office area is assessed as highly relevant (indicated by 100%), this area is well covered according to the schools. The results of the survey indicated a 20% gap.

Furthermore, process control technology was indicated as being relevant (80%). The gap in this area was estimated at 40% by the companies surveyed.

France

Demands from the Industry

Recruitment business understanding of the dairy industry and dairy skills are the three most cited areas for dairy companies in France. These are more than the average in other EU-countries.

In fact, French dairy companies have great difficulty finding employees (qualified or not) who accept the constraints of this sector that works 24/7 and whose factories are often far from urban centers. Companies in the dairy sector, and all food companies in general, have been working for several decades on their attractiveness and their image, but it is clear that they have not really succeeded. New societal trends (Vegan and non-animal values) as well as high-profile health crises do not favour this unfortunate image.

The French dairy sector consists of milk producers and private or cooperative processors. These actors are economically closely linked together and are often geographically very close. Milk is a highly perishable raw material and its transportation is complex due to food safety requirements. Moreover, the demands of the dairy market are becoming more and more complex. These particularities are very specific to the dairy sector and hence the organizational structure of dairy processing and the constraints suffered by the employees in the dairies must be understood within this context.

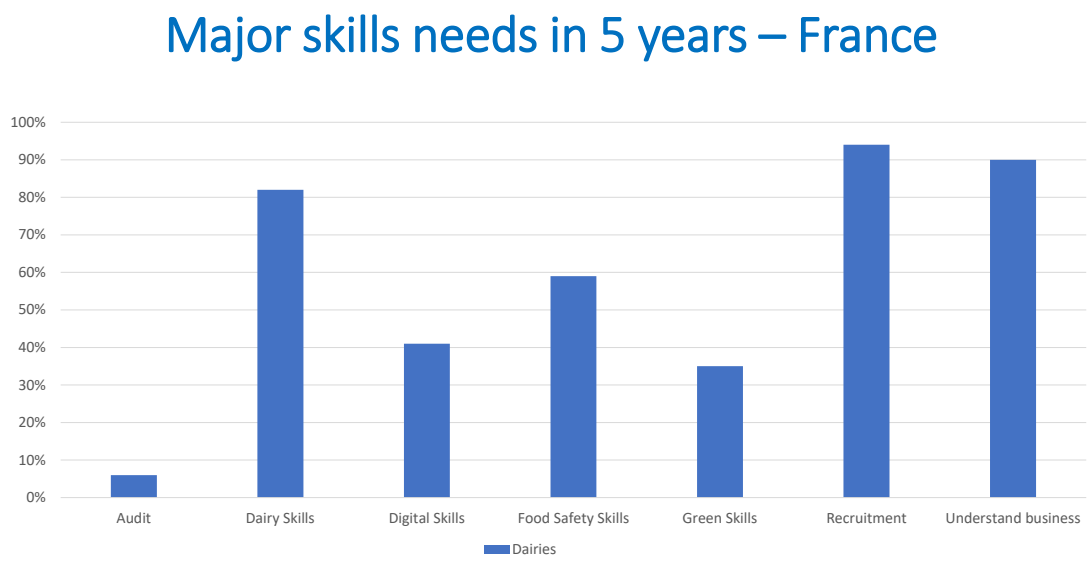

Figure 12. Major skill needs in 5 years in France based on the 7 categories which scored most need overall.

Finally, dairy skills are also mentioned by dairy companies. To know the raw material milk and to understand its variability, to adapt the processes to obtain quality products, to understand the fermentation processes to better control them, and so forth, so many key competences to acquire are required. This is especially the case in the cheese companies. The role of the cheese maker is always essential and fundamental in small cheese factories working with raw milk.

Skills in food safety and hygiene are also widely cited in France just at the same level as in the EU. European regulations on hygiene (food law, HACCP, traceability, microbiological criteria), as well as the standards followed by the companies (ISO 22000, IFS, BRC) and the enormous media impact in the event of a food crisis makes the food safety a priority for dairies. Hence, all employees must have good food safety skills.

French dairy companies cite the “digital” and “green” areas less than their European counterparts. Some large dairies are already very automated and equipped with ERP solutions. Their priority then becomes online data capture by employees for better responsiveness and process control. Others, usually small ones, are driving these changes. Concerning environmental topics, the dairies follow the regulations: declaration of activities, effluent management, waste management, etc. They also look for sources of savings and try to reduce their consumption of water and electricity. Some companies go further and engage in ISO 14001 type certifications.

Audit seems not to be of major concern as a competence for the future.

Gaps

By other high-ranking topics

These topics are compared to the overall educational supply from the educational institutions, demonstrating clearly the gaps

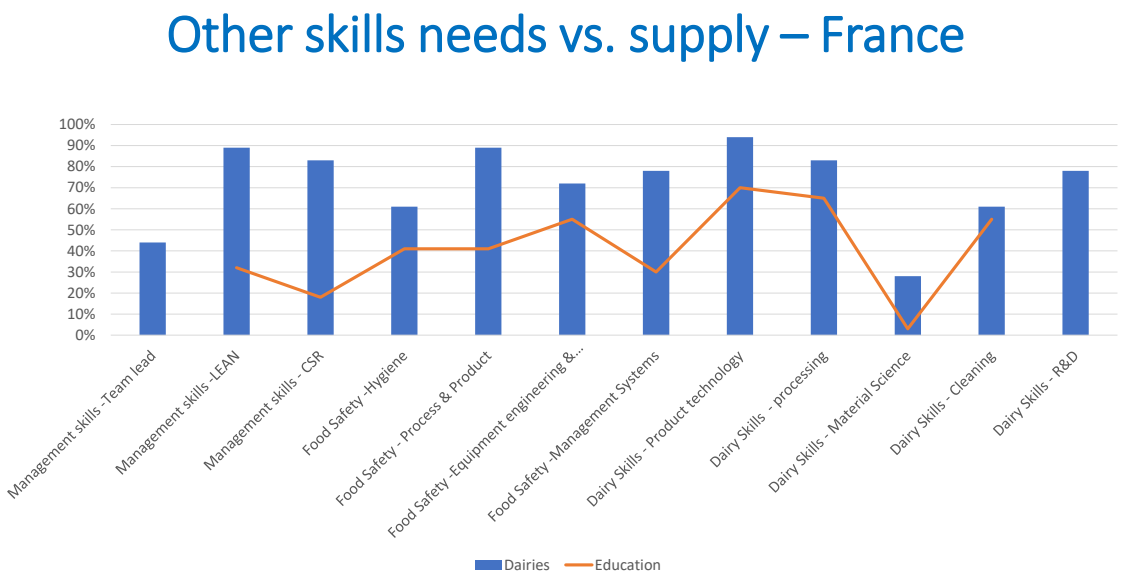

Figure 13. Other major skill needs vs. supply in France. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in France (orange line).

8 schools / universities (10 courses / diplomas) were interviewed. These are all 1 to 2-year courses mainly focused on the processing of milk and the manufacture of dairy products. Other training courses in management, food safety, packaging, etc. exist in France, they are just not specific to the dairy sector but to the food industry in general. These trainings were not included in the survey. The core dairy skills in French dairy training are very well covered, as are skills like hygiene, cleaning and food safety.

There is little dairy training in management or packaging. A student from a dairy education will have to specialize at another school / university to acquire skills in these areas.

Green Skills

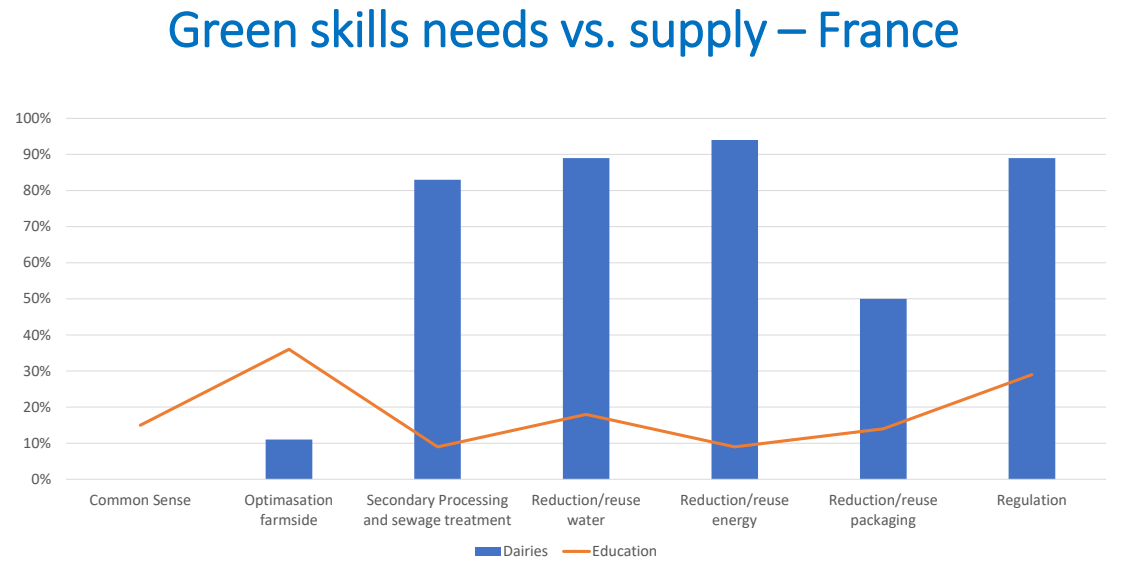

Figure 14. Green skill needs vs. supply in France. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in France (orange line).

There is no real environmental training in the dairy educations that were interviewed. Particularly in the areas of low carbon economy, natural resource management, climate change impact, etc. There are, however, specialized environmental courses (Bachelor or Master) in French schools and universities.

Only notions of regulation, effluent management and sorting of waste are addressed in dairy schools. In companies during internship and in educational workshops during practical work these basics are implemented and explained.

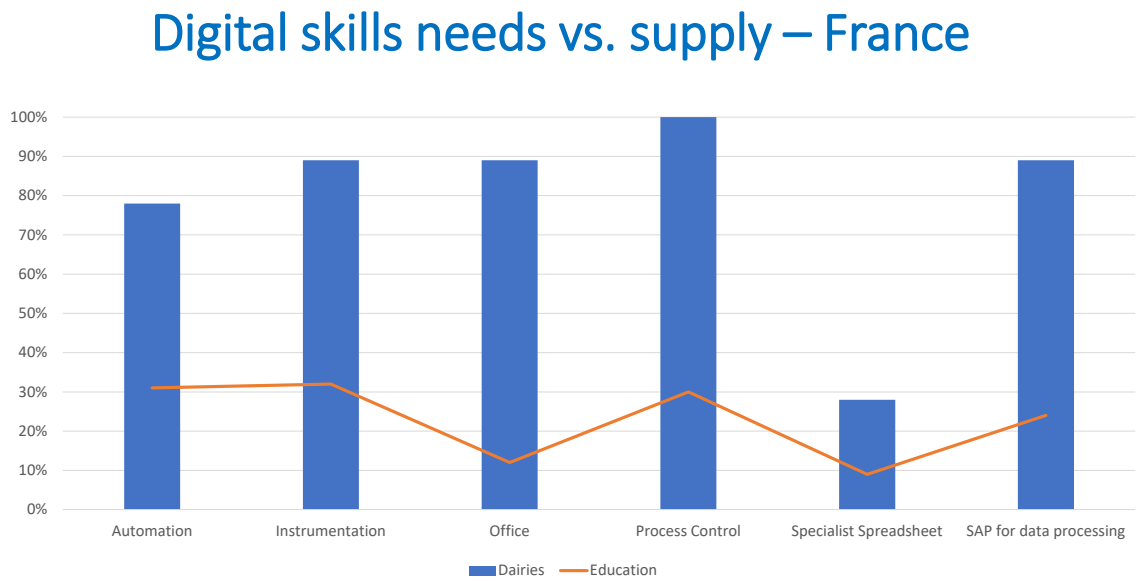

Figure 15. Digital skill needs vs. supply in France. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in France (orange line).

Digital Skills

Bachelor and Master level dairy courses no longer offer courses in the Office package. Basic Office--use is considered to be under control. Specialist spreadsheets and other types of spreadsheets are available but should be detailed.

ERP (Enterprise Resource Planning) software is not seen in schools and should be integrated into the curriculum (in theory and in practice during practical sessions).

Long courses (2 years - Bachelor - Level 4 to 6) include instrumentation, supervision or automation. Some milk formations (high level or very specific to processing) do not address these areas.

French partial conclusion

The schools and universities that were interviewed offer trainings of 1 to 2 years specific to the dairy sector. They are therefore very focused on milk as a raw material, dairy products and their manufacturing process. It is normal that they do not treat all areas.

A student has 3 to 5 years (or more) to acquire skills. After a dairy specialization in one of the schools and universities interviewed, he/she can specialize in a specific curriculum education in the function of his/her interests (management, packaging or environment for example).

Progress paths are nevertheless identified for current dairy training: integration of the concept of “understand business” and performance, increase the contributions to the environment and ERP software for example.

Austria, Italy and Luxembourg

Of these three EU member states, only Austria provides the possibility of a special dairy training in a dairy school or training institution. As in Germany, training as a milk technologist is conducted in a dual system (see also the introduction to the German analysis). Like Germany, Austria also provides a training programme leading to the title of Dairy Master.

In Italy, the trainees living in the region of South Tyrol are either sent to one of the German or to one of the Austrian training centres to attend the special dairy training programme. In the other regions of Italy, there is no particular dairy training programme. Training primarily takes place in the dairies, by transfer of information and in-company know-how by the employees already working at the plant.

In Luxembourg, the particular dairy training programme is carried out by regularly sending the trainees to one of the German or one of the French training centres.

Higher education in dairy science and technology is not offered in any of these countries.

In Austria, four dairies (three large dairies and one small dairy) were interviewed, in Italy eight dairies (four medium-sized and four small dairies) and in Luxembourg one large dairy were surveyed.

Demands from the industry

In all three countries, the greatest need (indicated by 100% of the surveyed dairies) is currently believed to be in the area of personnel recruitment *(see figure 16)*. This field of action, which was not underlaid with additional specific questions in the questionnaire, can again be subdivided into the following areas:

1. *To find and retain qualified employees*
2. *To qualify lateral entrants*
3. *To retain expert knowledge (also from older employees) within the company*

With 100% in Luxembourg and 50% in Austria and Italy respectively, the skills related to dairy processing rank on the second place of the needs.

With 62% in Italy and 50% in Austria, the next priority is the need for the employees in the dairies to understand the milk market – which meanwhile has become a world market – and the complex processes from milk production and ensuring long-term supply of raw materials to milk processing and marketing, so that the employees can identify themselves with the employer.

Only 62% of the dairies interviewed in Italy indicate a need for skills regarding digitalization.

In Austria, the need for skills regarding food safety requirements ranges at 25% and in Italy at 12%.

Only in Italy green skills range at 12% of the total evaluation. This may be explained by the fact that these topics in those countries are not considered to be directly associated with dairy processing and therefore do not play a role for the respondents.

With 0%, the need for skills regarding the conduct of audits is at the bottom end of the scale, which is due to the small-scale structure of the dairy plants and food retail trade in these countries.

Demands from the Industry

By selected topic

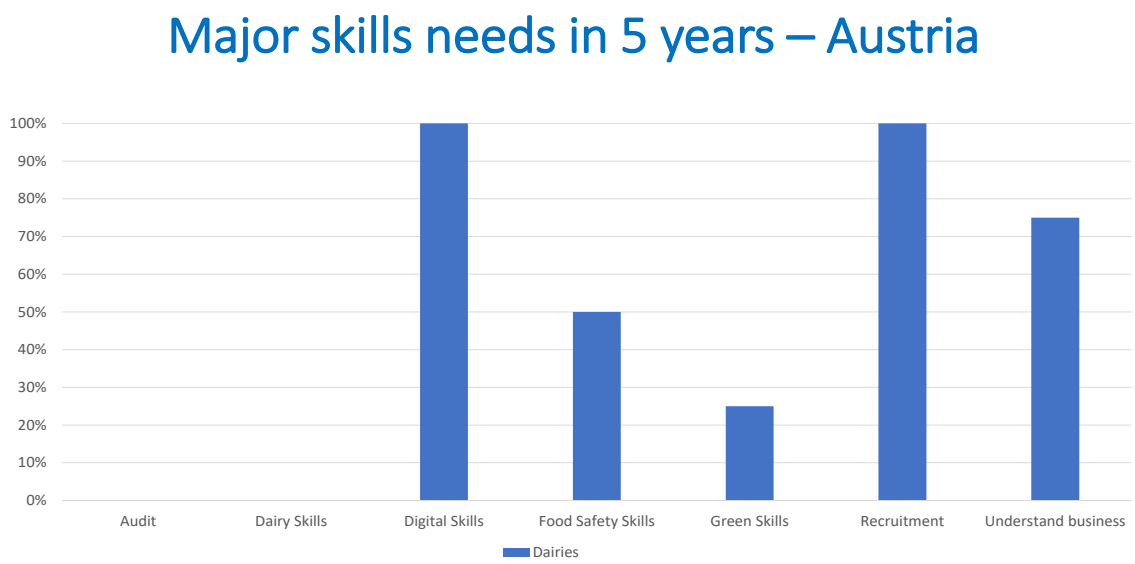

Figure 16. Major skill needs in 5 years in Austria based on the 7 categories which scored most need overall.

When regarding the major skills needed in Austria in the future it becomes obvious that the dairies in Austria assume that sufficient dairy expertise and skills will be available. Audit skills are not considered important for the future, either. In contrast, personnel recruitment remains the key challenge, followed by the need for digital skills, since everybody expects automatization to progress rapidly. Understanding the dairy market will increase in importance (75%). Food safety and environmental protection will also increase in importance.

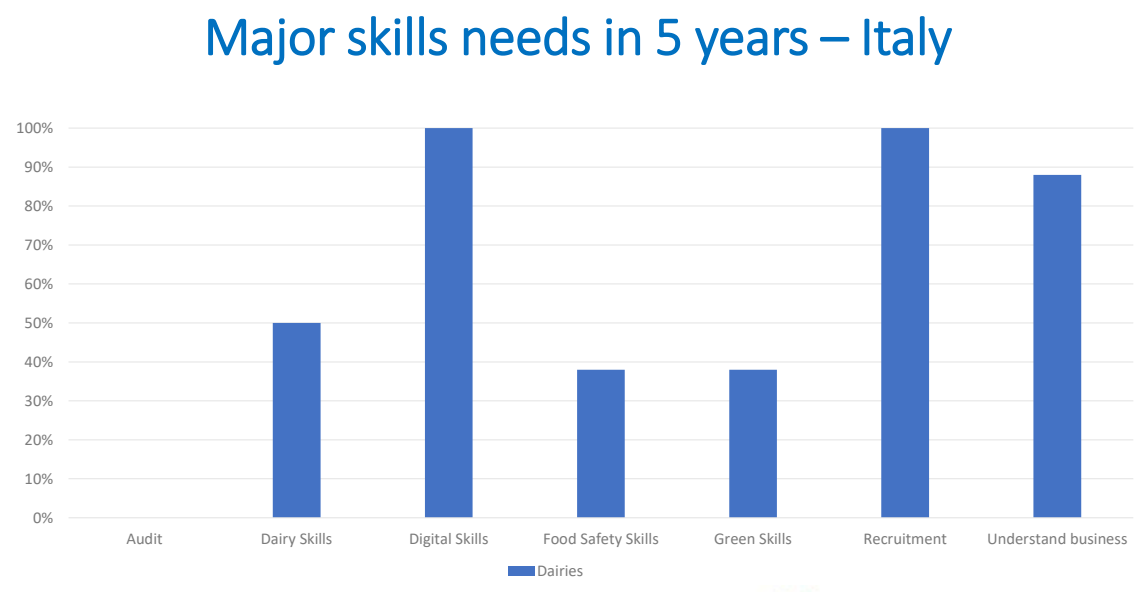

Figure 17. Major skill needs in 5 years in Italy based on the 7 categories which scored most need overall.

The dairies in Italy anticipate that recruitment and digital skills will be the most important challenges, since here, too, it is expected that automatization will proceed at a faster pace. Understanding the dairy market will become increasingly important (87%). Food safety and environment protection will also gain in importance.

Dairy expertise and skills will remain to be important. Audit skills are not considered to be important in the future, either.

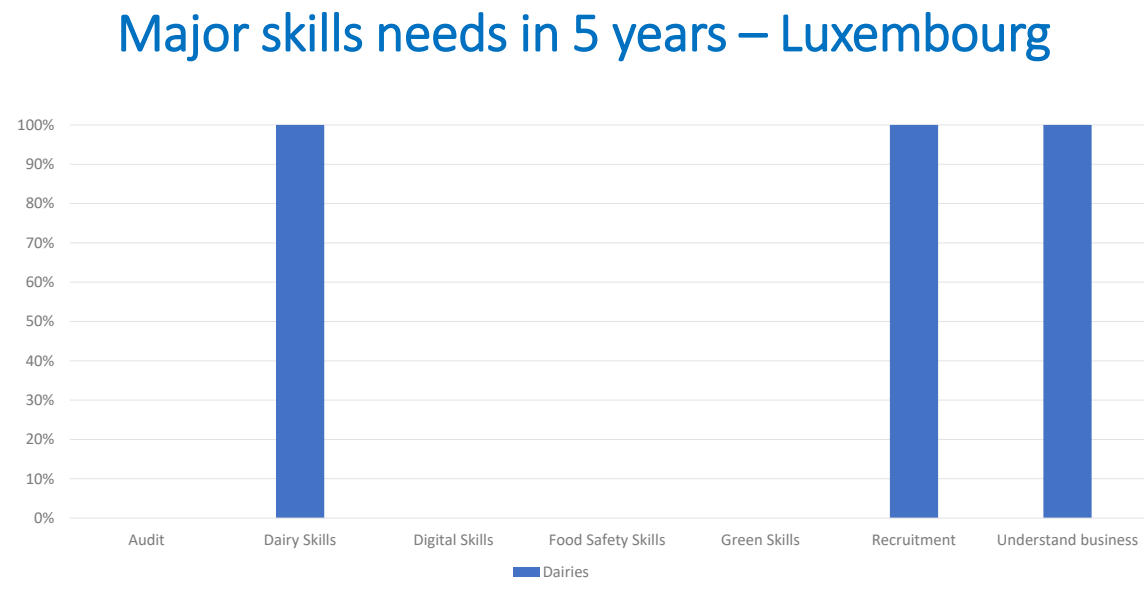

Figure 18. Major skill needs in 5 years in Luxembourg based on the 7 categories which scored most need overall.

For the dairy in Luxembourg, dairy expertise and skills of their employees in the production area as well as recruitment is of vital importance. The understanding of the functioning of the dairy market also ranks high. The other skills are not considered to be important in the future.

Gaps

By other high-ranking topics

These topics are compared to the overall educational supply from the educational institutions, demonstrating clearly the gaps.

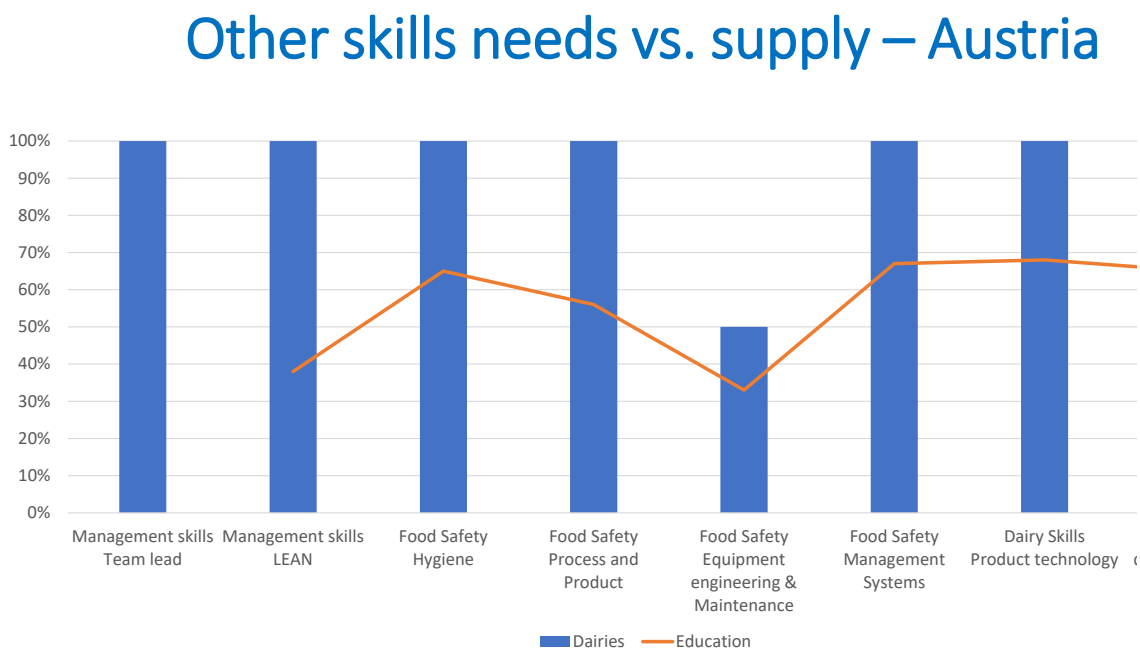

Figure 19. Other major skill needs vs. supply in Austria. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Austria (orange line).

The theory on dairy and food safety skills is quite well covered by the schools and higher educational institutions in Austria (all indicate more than 50%, except for maintenance).

Gaps

The dairies surveyed believe that team skills / team management skills and management skills (lean) are of vital importance. As regards education in team management skills questions were not asked specifically to the educational institutions, however, it is also known that company instructors normally do not have enough time for training team management skills.

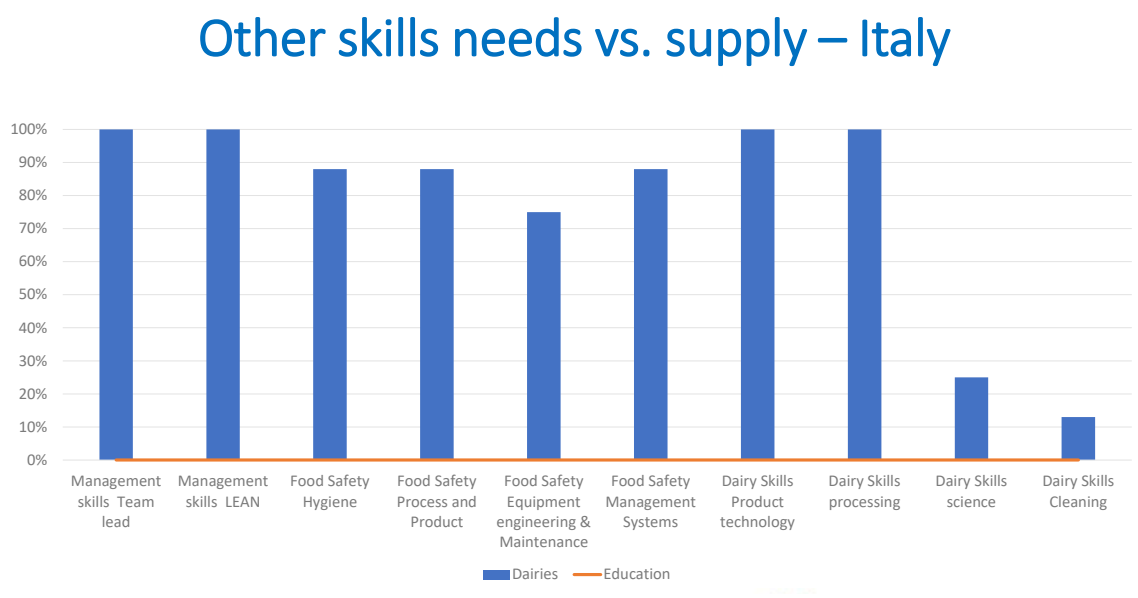

Figure 20. Other major skill needs vs. supply in Italy. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Italy (orange line).

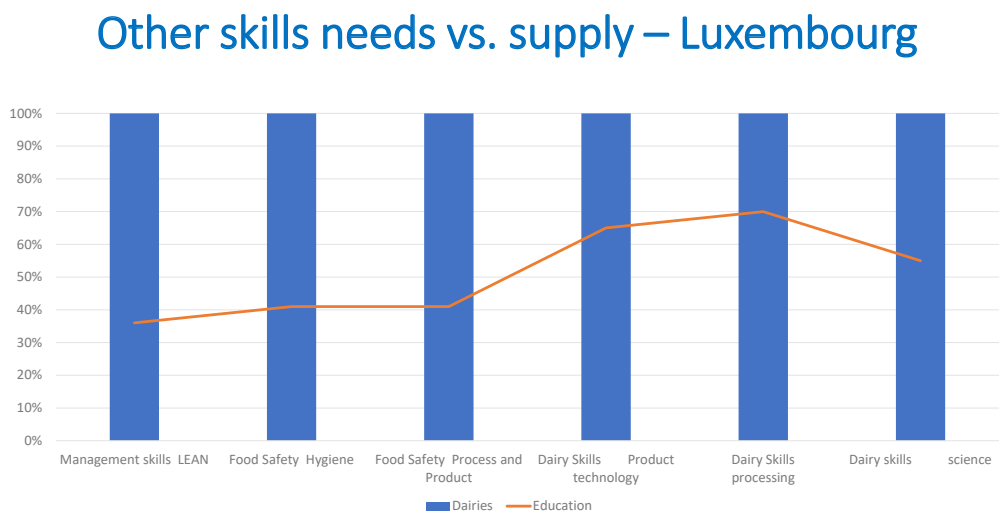

Figure 21. Other major skill needs vs. supply in Luxembourg. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Luxembourg (orange line).

In Italy and Luxembourg, too, team management skills, management skills (lean) as well as specific dairy processing skills are considered to be of outstanding importance (100%). Except for scientific and cleaning skills (below 25%), all other skills are regarded as very important by the respondents (more than 75%). Since Italy and Luxembourg do not provide a dairy-specific training, nothing can be indicated as to the gaps between the need of the dairies and the skills imparted through education and training. The relation between the knowledge and skills obtained through training and the needs of the dairy in Luxembourg can only be evaluated if this is seen in relation to the skills imparted in German and French training centres. No conclusions can be drawn from this.

Green Skills

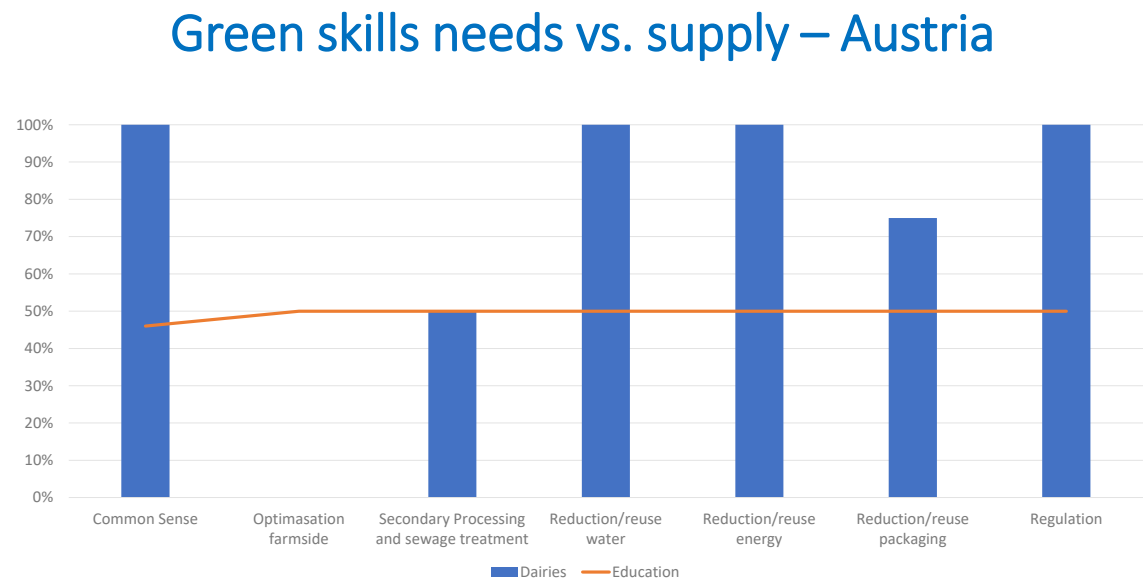

Figure 22. Green skill needs vs. supply in Austria. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Austria (orange line).

For the dairies in Austria, environmental protection has a high priority, which is also due to economic reasons (in 7 subsections, 100% priority is scored four times). In this EU member state, which is highly specialized, the section of optimization of milk production at the farmside is only of minimal importance. In regard to the other green subsections it is apparent that Austrian dairy plants rate the green agenda very high. Especially in regard to the reduction and reuse of water and energy, as well as knowledge of environmental legislation and regulation. The gap between the importance to the dairy plants compared to the actual green teaching at the educational institutions is considerable with around 50 %. Only secondary processing and sewage treatment turns out to match between the claimed needs from the dairies and the educational supply.

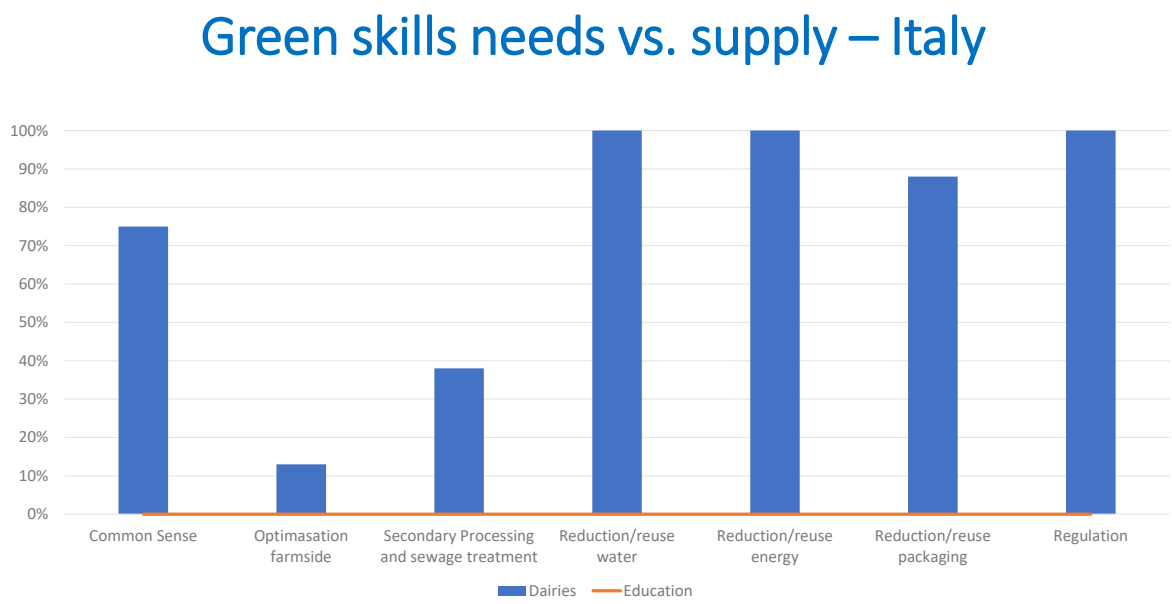

Figure 23. Green skill needs vs. supply in Italy. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Italy (orange line).

In Italy, the need for green skills is rated very high with 100 % in regard to reduction and reuse of water and energy, as well as knowledge of environmental regulation and legislation. Furthermore, reduction and reuse of packaging is also rated very high, with almost 90 % of dairy plants considering this area important. As there is no actual dairy education in Italy, the gap is of 100 % for all topics.

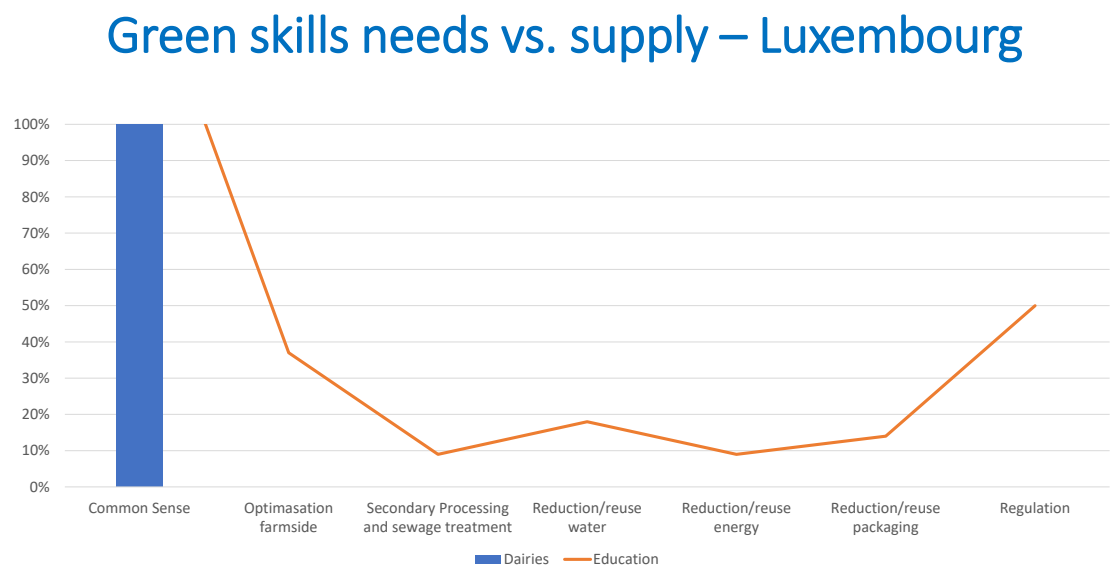

Figure 24. Green skill needs vs. supply in Luxembourg. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Luxembourg (orange line).

In Luxembourg, skills relating to environmental protection are mainly owed to social acceptance. If more skills are imparted here than required by the dairy, this is due to education and training provisions in Germany or France.

Digital Skills

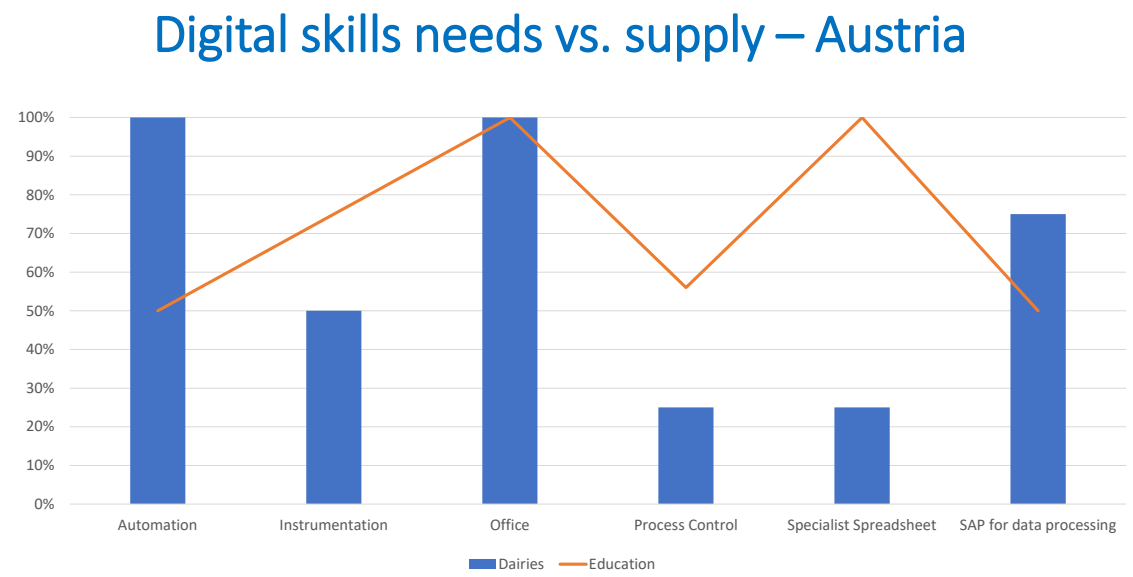

Figure 25. Digital skill needs vs. supply in Austria. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Austria (orange line).

Altogether, digital skills are an important topic for the dairies. Mastering the office software is regarded as one of the most important areas, which is provided by the training institutions according to the specific needs of the dairies. Skills related to automatization score at 50% and are thus below the required level. Regarding the remaining areas, the knowledge imparted exceeds the actual need.

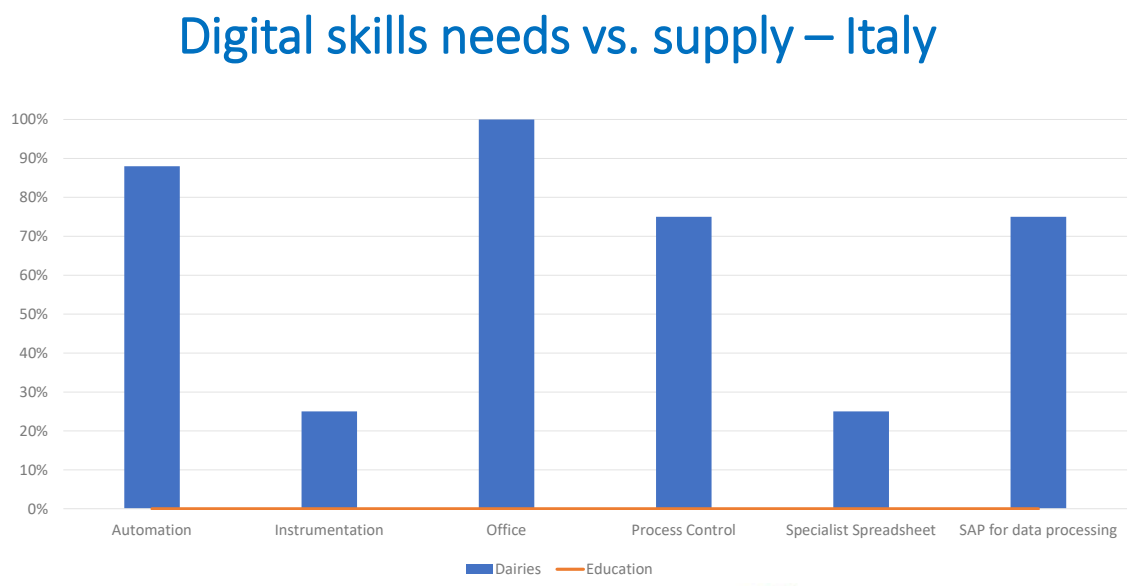

Figure 26. Digital skill needs vs. supply in Italy. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Italy (orange line).

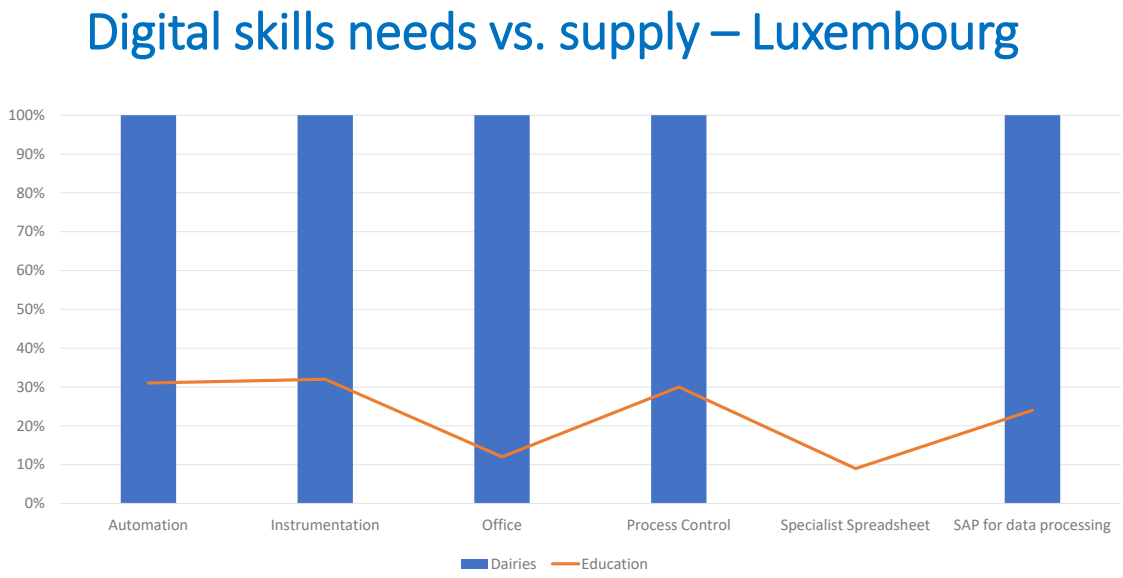

Figure 27. Digital skill needs vs. supply in Luxembourg. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Luxembourg (orange line).

For the dairies in Italy, digital skills are an important topic and in Luxembourg they are a very important topic (100 % for all topics but 'specialist spreadsheet'). The gaps in Italy are, as with the other areas, 100 % due to the lack of actual dairy training. In Luxembourg there is a very little teaching in digital skills, with between 10 and 30 %, which indicates gaps of up to 90 %.

The Netherlands

In the Netherlands one major dairy was interviewed, three educational institutions (one VET, one university and one university college), who all teach dairy, but at different levels.

Substantial investments have been made in recent years by the Dairy and Food companies to increase production capacity. In the province of Friesland, in the North of the Netherlands, alone, companies such as Royal FrieslandCampina, Royal A-ware, Fonterra and Ausnutria Hyproca have invested more than half a billion euros in new construction and adaptations in response to rising world demand. And in the Netherlands, as in most other European milk producing countries, milk production has also risen due to the abolition of the milk quota.

This growth, in combination with the aging population, is a major challenge for business and education. From a market analysis from 2015, it became clear that the demand for well-trained and trained staff will increase even more in the coming years. Employment will increase in absolute numbers, but there will also be a demand for replacement that will continue to grow. This includes all levels of education from MBO through HBO to university graduates.

The province of Friesland is traditionally known as a province with a rich food tradition, particularly in the dairy sector. There are food companies with a prominent market position, but an important infrastructure in terms of knowledge and services has also arisen around it. This has been an international leader for many years, in the past the ‘Suvelskoalle’ in Bolsward was the symbol for this.

With increasing competition on the world market and the acceleration in the economy, companies, knowledge institutions and governments in Friesland wanted to continue to expand this leading position through the program Dairy Chain in 2016.

DairyChain

The DairyChain program is not an isolated program. With the establishment of the Dairy Campus (owned by Wageningen University & Research) in Leeuwarden, an important strengthening of the knowledge infrastructure in the field of dairy farming and dairy has already been realized in Friesland. Dairy Campus is a partnership with partners such as Wageningen UR, Wageningen Livestock Research, Nordwin College (VET), Van Hall Larenstein University of Applied Sciences and Royal FrieslandCampina.

With the DairyChain program the plan is that, in addition to the research, knowledge development and dissemination of knowledge. Central to the first phase of DairyChain is a unique education program with a continuous “Frisian” learning line (VET-bachelor-master) that provides an approach for the total FEED TO FOOD in the Northern Netherlands based on market needs and with international ambition. With this initiative, the DairyChain partners respond directly to the new education policy. Moreover, they supplement this with a research program in which the transfer of new (fundamental) knowledge to both education and the business community is paramount.

DairyChain does not stand alone, the program builds on the foundation of Dairy Campus. Where Dairy Campus concentrates on dairy farming through an innovative programme for companies and an educational programme, the DairyChain programme supplements this with a program for the entire chain. This programme does not only consist of an educational programme (phase 1), it also provides for fundamental research (phase 3) that is not included in the Dairy Campus and in facilities such as a Food Application Center or Technology (FACT, phase 2).

Goal

The objective of the DairyChain initiative is to grow Leeuwarden into an international knowledge and expertise center for education, research and innovation in the field of primary agriculture and food with dairy in particular. DairyChain phase 1 has been completed and the ongoing education curriculum in food technology with the specific focus on dairy is on. It is the missing piece in the dairy chain next to the Dairy Campus, which focuses on dairy farming in all its facets. National communication and recruitment activities started when the educational products and facilities were actually under development and about 80 students (VET & bachelor) graduate each year.

Even DairyChain, phase 2, has been released and the right facilities are located at Van Hall Larenstein for industry and SME to do their research on pilot scale.

But as product development continues, the demands in the industry increase as well. And therefore, in the reflections below it comes apparent that there is still room for improvement. A lack of response (n=1) on industry side, might not give a general Dutch view. On the other hand, the developments that the researcher has seen in Netherlands, are comparable with the results below and ask for a future with more digitalization and higher education level on the same spot.

Demands from the Industry

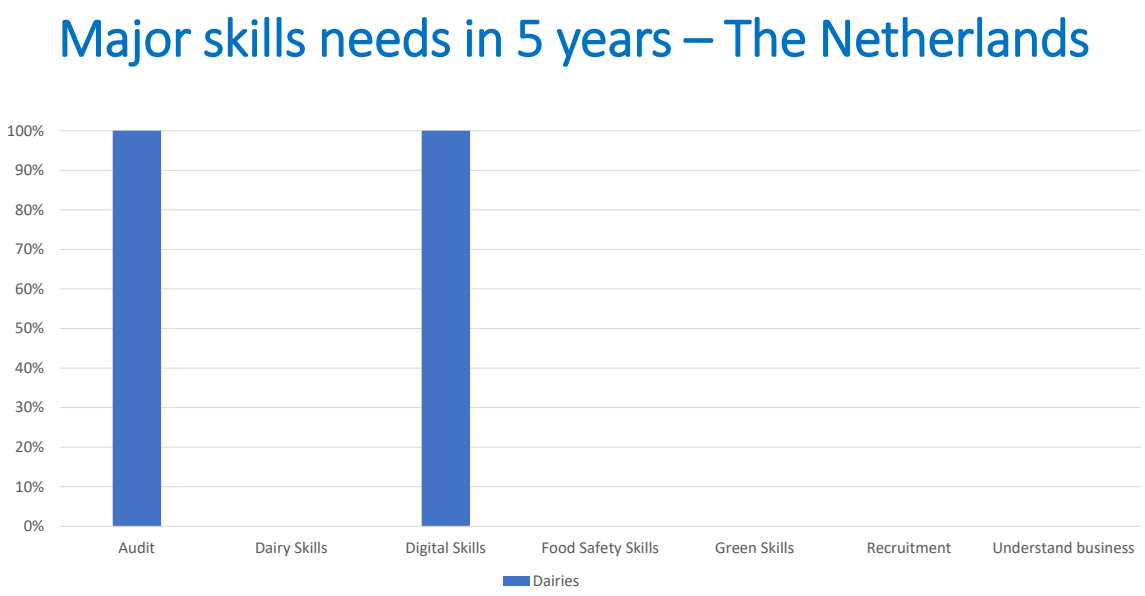

Figure 28. Major skill needs in 5 years in the Netherlands based on the 7 categories which scored most need overall.

Due to cost savings and continuous improvement in the dairy industry, the industry is investing a lot in digitalization. More processes are being automated, and the process control is changing its nature. In the past, process operators had to turn on switches by themselves or could make changes in the process by turning the wheel with their hands. Nowadays, process operators are more focused on coordination of deviations and malfunction (quality and technical). Working with their hands has changed into inspection and first-line maintenance, but even more into cause analyses and improvement proposals.

Gaps

By other high-ranking topics

These topics are compared to the overall educational supply from the educational institutions, demonstrating clearly the gaps.

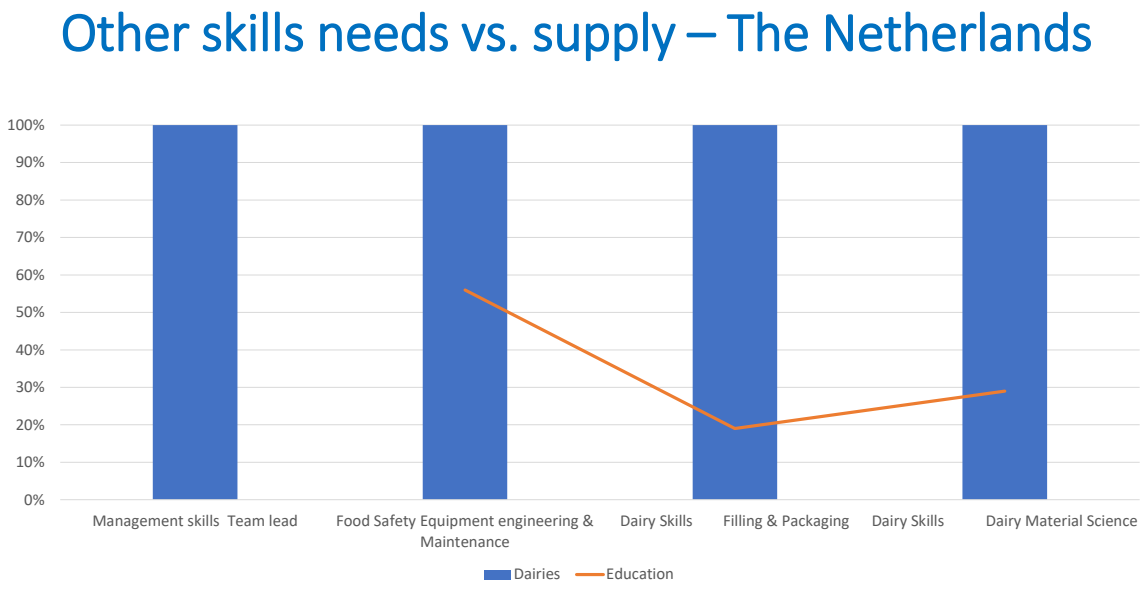

Figure 29. Other major skill needs vs. supply in the Netherlands. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in the Netherlands (orange line).

The needs of the dairy industry expressed in graph 29 are not a complete picture of the situation of the dairy industry in the Netherlands, as only one industry responded to the questions. However, this dairy plant is representative of the rest of the sector and hence the answers are valid as an overview of the actual challenges.

The biggest gaps identified in the research were in regard to management skills namely 'team lead', which was rated at 100 % of importance. For the industry, cocreate as colleagues, teamwork and solving problems together are challenges. The development of those competences into educational programmes is already happening. Even a demand from the industry is to have less management and to get a more agile way of working, will not be a problem. Group work and applied research is already done in crosslinking educational programmes and working in teams.

Other demands from the industry that are rated with 100 % are Food Safety with the sub-category 'Equipment engineering & maintenance', which is only taught little more than half of what is needed. Within dairy skills there are demands for knowledge about 'filling & packaging' and 'material science', both of these are only covered by the educational institutions with between 20 and 30 %..

The focus of the industry is somewhat focused on education on vocational level. They ask that training suppliers and the education offer on dairy skills, to be sufficient, specific educational programme on vocational and bachelor level. Specific within Life Sciences (bio-medic, food, chemistry) on each level. The industry prefers a more practical, direct link with the workplace. For example, providing teacher's internships at the plants. At present, theory is taught first at the colleges and universities, whereas students would benefit from being exposed to practice earlier in their studies or concurrently.

Therefore, for the industry work-based learning would be more efficient as everyday work-issues are the input for individual and self-organized learning objectives. The focus is on practical results in a real working environment.

Green Skills

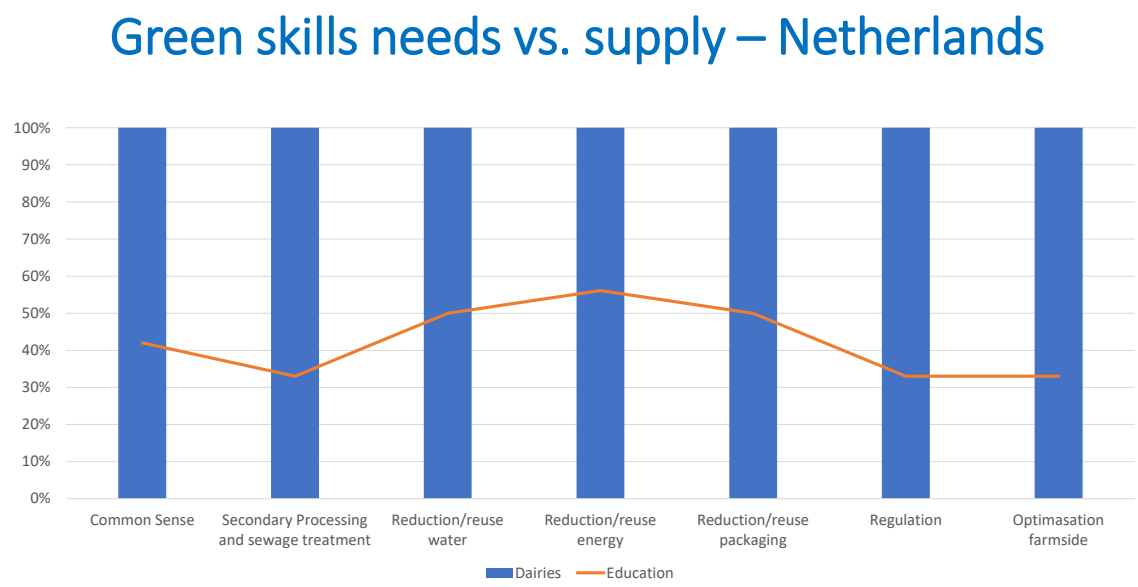

Figure 30. Green skill needs vs. supply in the Netherlands. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in the Netherlands (orange line).

In regard to green skills, the industry in the Netherlands considered all parameters of considerable importance. Especially, there is focus on a better use of the different resources (energy, water, etc.).

The dairy plant (large) that was interviewed has created a route for the next decade in which they want to have a sustainable growth and value creation, providing the growing world population with the right nutrients is the key challenge in the coming decades. Their purpose – nourishing by nature – stands for better nutrition for the world's consumers and a good living for the farmers, now and for generations to come. To achieve these goals, they will need employees with more green skills, but more that skills, this dairy asks of its employees to have a green attitude and awareness of sustainability and the green agenda.

Digital Skills

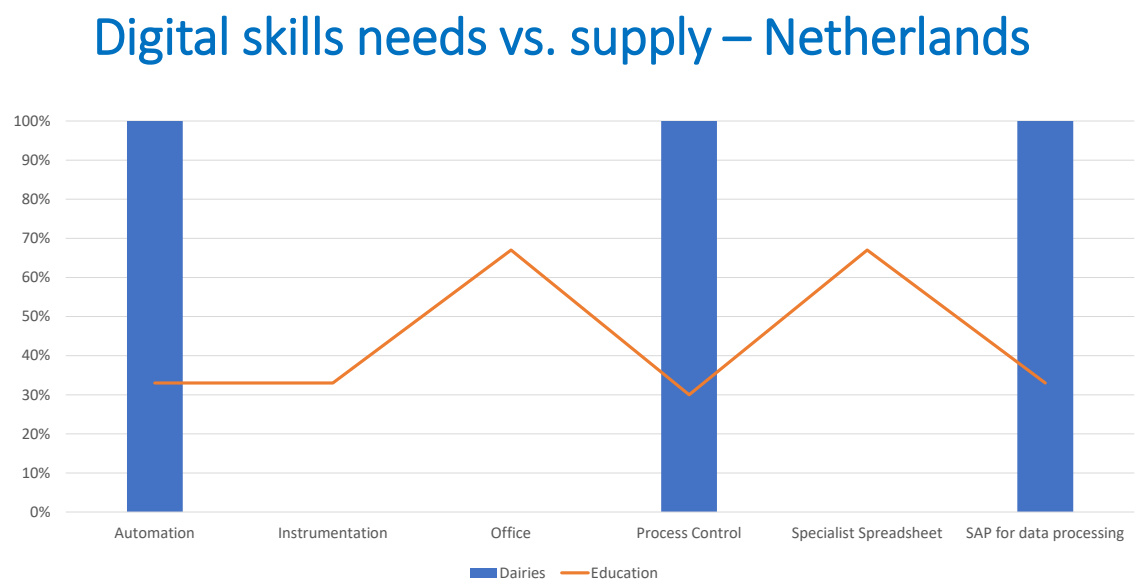

Figure 31. Digital skill needs vs. supply in the Netherlands. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in the Netherlands (orange line).

The industry expects changes in the next 5-10 years. Especially the adjustment of the process by the implementation of more automation will require more employees of at least BSc level, who need to work in shifts. High automation-based systems such as ERP and MES scanning and thus smart factories and industries with a high level of automation create a need for employees with good levels of digital skills to handle and manage automated dairy sites. Interestingly, where the dairy plant is less concerned about the availability of skills is where the educational institutions seem to perform better (teaching in the Office-package and Specialist spreadsheet). Whereas the areas that are of greater concern to the dairy plant are only rated at 30 % teaching, meaning that of 3 educational institutions that were interviewed, only one offer teaching in instrumentation, automation and SAP for data processing.

The ongoing digitalization is rapidly changing industries into smart factories, and this will continue for the next decade. New and advanced technology will require employees with advanced digital skills, and hence the educational institutions must follow-up and include more digital learning both as teaching methodology as well as specific teaching in instrumentation and automation.


BUSINESS
BUSINESS
WORLD
STRATEGY
PLAN
INVESTMENT
INCOME

Denmark

In Denmark 10 dairies were interviewed, three educational institutions (1 VET, 1 university and 1 university college), who all teach dairy, but at different levels. Furthermore, five ex-students were interviewed with the aim of verifying whether they believe that they received the right teaching compared to what the industry expects from them when they are employed in regular jobs, as well as validating alignment between claimed and perceived educational output.

As an overall reflection the ex-students claim that any job position, they wish to apply for, require green and digital skills at a quite broad and at times specialized level. According to the questionnaires, those are skills that are generally not taught at the schools at any level. Furthermore, the ex-students all pointed out the need of being taught about organic products, baby formulation and whey products, as the demand for such products have increased.

One of the overall reflections from the industry is that they find it challenging that management as a general trend do not have a background in dairy.

When site managers were asked which skills they expect from employees and which they find are lacking, they pointed out the capability of troubleshooting – and this is quite general across job positions. In this sense troubleshooting is both related to digital skills: being able to read and analyze data from e.g. process control technology, and act on them. As well as, to be able to understand what happens in processing equipment, i.e. basic product technology and raw material processing, and being able to make sound decisions.

Demands from the Industry

In Denmark the difference between which kind of skills the industry demands at present stage and what they expect to be needing in 5-years' time, was not significant *(see figure 32)* – only green skills are expected to be of much more concern than today. The lack of considerable difference between today's needs as compared to future needs is interpreted as future needs already being needs at present, reason why this analysis only reflects on future needs.

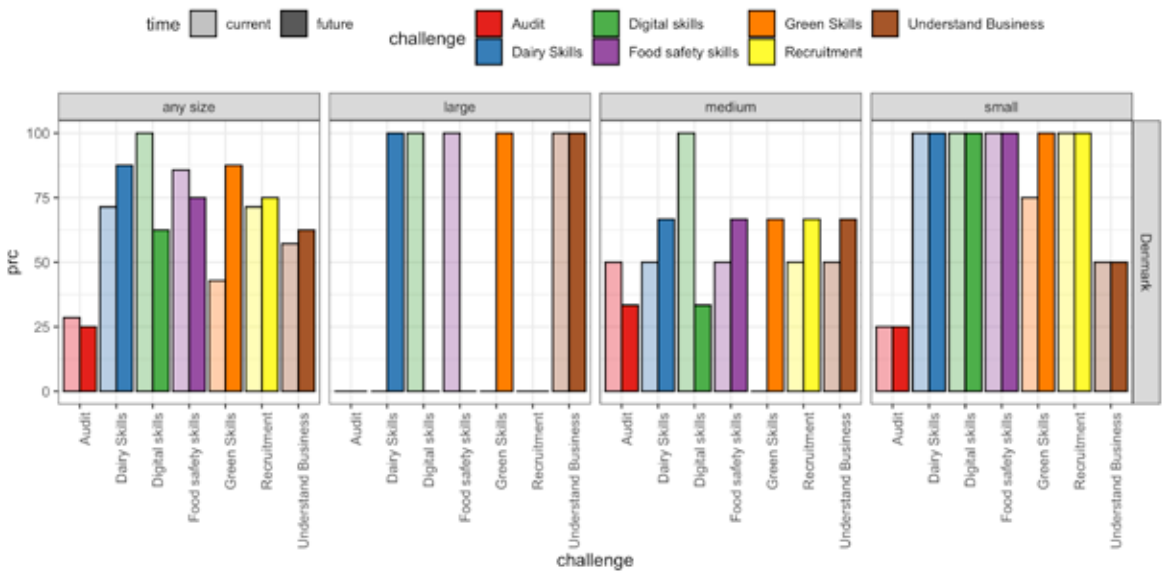

Figure 32. Comparison of dairy skill needs at present (light colored) and future (dark colored) based on the plant size (small < 50 production employees (PE), medium: between 50 and 150 PE and large: > 150 PE)

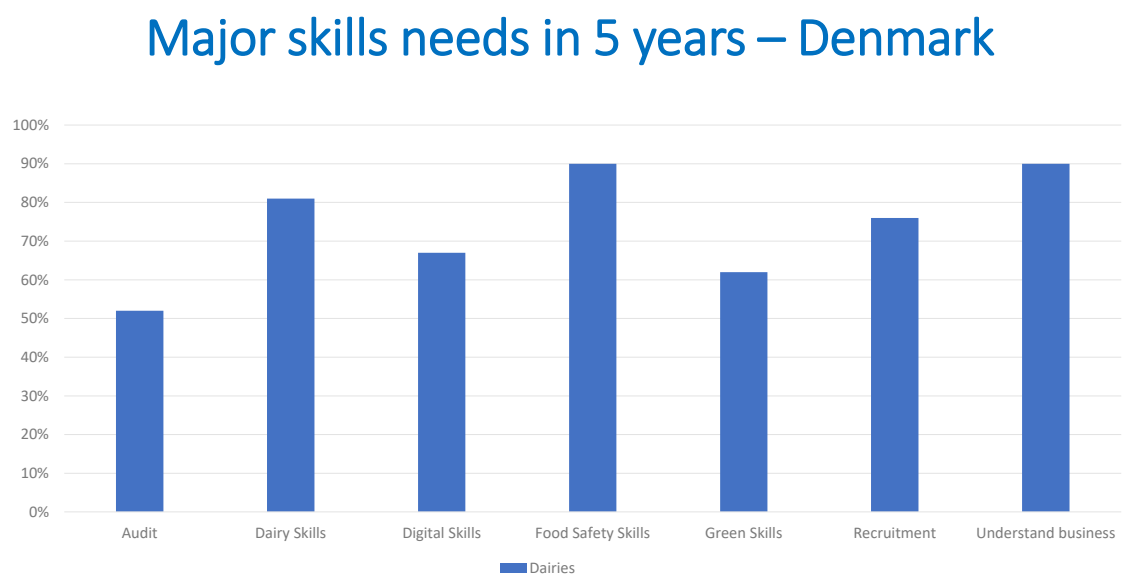

Figure 33. Major skill needs in 5 years in Denmark based on the 7 categories which scored most need overall.

The 14 countries that participated in this research appeared to have seven major topics that came across as most relevant for skills needs. Some of the topics, like 'recruitment' and 'understand business' appeared as specific concerns, even when the dairies were not asked specifically about these.

The topic Understand business scores very high in the Danish surveys, with 90% indicating it as a major concern. Business understanding in this context is probably due to increasing expectations

for employees to understand the whole supply chain in whichever position they are employed. They need to understand the needs of the consumer, as well as understanding where the product comes from. From farm to fork is the key. Past years' more narrow specialization seems no longer to be sufficient. Understanding business is furthermore explained in the surveys as *'the understanding of the consequences of a change in one part of the production as regards the whole production'*. At a more general level the dairies stress *'the lack of overall complex understanding – how different processes affect other processes.'*

Recruitment is of major concern to 75% of all dairies. This bearing in mind that about seven years ago the Danish dairy sector created a task force with the objective to increase enrollment to the dairy education. The task force with the name of 'the industry group behind the dairy master' worked out an intense campaigning to attract more young people to the dairy master - and hence the dairy sector. The campaigning helped increase the enrollment to the education with 300 % over the past 5-6 years. Even with the campaigning and the increase in young dairy students, the dairy education and the sector generally, still suffers from an old-fashioned image, which makes it difficult not only to attract employees with the right skills to the sector, but also to retain them. Other competing sectors like ingredients or pharmaceutical often offer better working hours and a better balance between work and family life, which seem to be of high priority to the younger generation. Today only four out of ten dairy graduates remain in the industry once they finish their education. The retainment is also a challenge as regards dairy operators and production workers.

The high score on food safety (90%) must be seen from different perspectives. Food safety is inherent to the dairy sector due to the fact that milk is a highly perishable raw material. Hence, food safety is of very high priority to any level of job position. Likewise, customers have increasing requirements to food safety, which puts pressure on the dairies, and finally, food safety is heavily regulated not only at national level but also from the EU. Last but not least the various examples on food fraud, like for example the melamine milk powder scandal from China in 2008, and the many salmonella cases from the meat industry, have increased the pressure for food safety management, creating systems like HACCP, TACCP and VACCP. All these initiatives require employees with solid food safety qualifications.

The figures on digital skills drop a little from the needs at present to the needs in 5-years' time. This is certainly not due to expectations of less needs for digital skills among employees, on the contrary. Thus, the drop must rather be seen in lieu of the dairies already integrating digital solutions and upgrading skills internally. Furthermore, an explanation could be that the dairies expect students to graduate with a higher level of digital competences than previous generations.

On green skills dairies are aware that the green agenda will accelerate considerably in a few years. This, adding to the dairies not being well equipped for what is already needed. Moreover, current trends from larger companies, like Arla Foods' recent strategy which main target is to reduce greenhouse gas emissions by 30 per cent per kilo of milk over the next decade and by 2050 have net zero carbon emissions. Likewise, the Danish Food and Agriculture Council launched a campaign in 2019 with similar content. These trends are very likely to create a trickle-down effect bringing medium sized and smaller dairy companies on board - as well as the primary production.

When the dairies were asked to point out the areas, they expect to change in regard to green or environmental issues, they almost unanimously said '*optimization on energy savings'*; '*reduction and reuse of water*', '*better performance on waste (energy and resources)*', and '*better performance on packaging'*. These topics are either not available in the educational curricula or not taught as green skills.

Dairy skills are key to the dairy companies. Obviously, some positions require a higher level of dairy skills than others. But even when you 'only' work with equipment, you need to have some

knowledge of the raw material running through the pipes. Hence a very clear message from the dairies is *not* to scale down on dairy skills teaching. However, the dairies do claim that employees lack *'overall complex understanding of how different processes affect other processes'* and *'the ability to link matters'* These are skills that seem to be lacking in the newer generations of dairy educated. Furthermore, as regards dairy skills, the interviewees claimed to be needing employees with specific skills on *extended shelf life* and *innovative thinking*.

Gaps

By other high-ranking topics

The gaps that appear below are the ones that once analyzed, resulted to have the greatest gaps between what the industry demands, compared to what the educational institutions provide. The topics here are more specific into subcategories - for example 'dairy skills' is subdivided into 'product technology', 'processing', and 'Research and Development'.

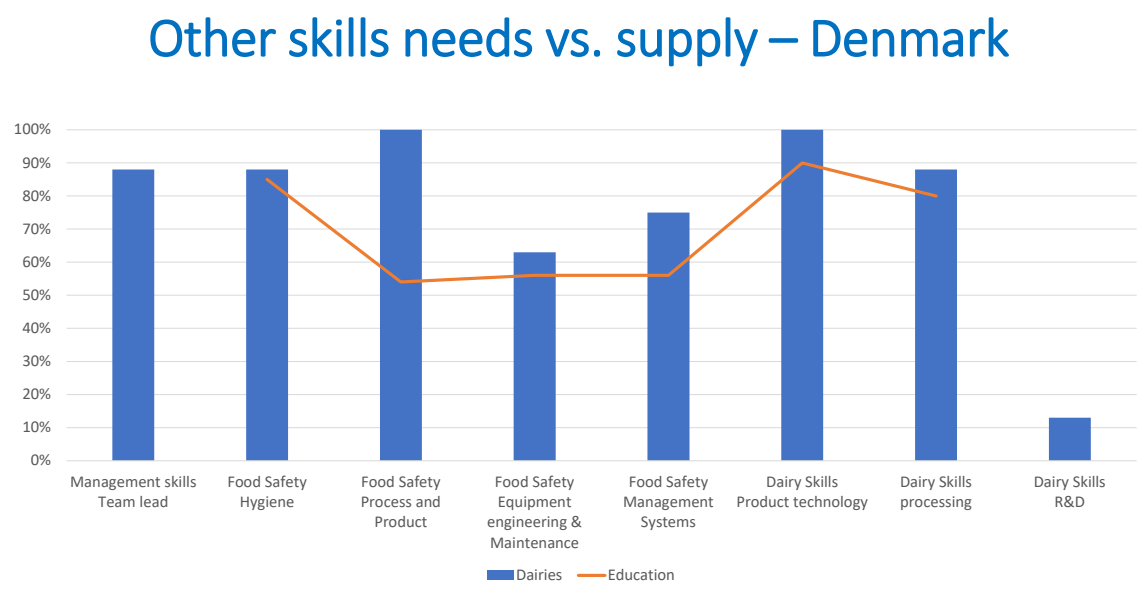

Figure 34. Other major skill needs vs. supply in Denmark. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Denmark (orange line).

Management skills are mainly seen as a requirement for a more independent job performance, regardless of the type of job. That is, even when you do not lead a team, you need to be able to be the lead of your own performance and time.

As regards the lacking educational output in this area, the Danish dairy education has traditionally focused more heavily on the core dairy skills and regarded topics as management skills as something to learn 'on the job'.

Food safety in relation to process- and product knowledge is generally a priority in all dairies. Here, the educational output does not fully match this need. This is definitely an area of concern to re-consider with the educational institutions, as food safety is ranking high on all agendas.

As far as the other food safety areas like 'equipment, engineering & maintenance', 'management systems' and 'product technology' are concerned: while the priorities have high scores, it is not necessarily dairy employees that are responsible for this, and hence, the educational suppliers should not necessarily integrate more teaching in these areas. Other job positions that hold part of these responsibilities are Environment, Health & Safety (EHS), and Quality, Environment, Health & Safety

(QEHS). This means that it is not necessarily a critical concern for the educational institutions.

Within the area of Dairy skills, Research and Development is of concern to only a few dairies (12%). When asked of which skills related to research and development are needed, the dairies point towards innovation and product development, consumer trends and market knowledge, technological development and new technology.

At the educational level the educational institutions were not asked about R&D-teaching, but we know that only the MSc-students from University of Copenhagen have R&D on the curriculum amounting to half a semester. The other two educations do not contemplate this area for teaching.

On product technology and product processing the scores are really high (100% and 88% respectively), whereas the schools do not fully match this need. Especially, on dairy technology the dairies demand a more thorough understanding. For example, it is not enough to know the content in milk for proper processing, it is just as important to understand what proteins actually do and which functions they have.

Green skills

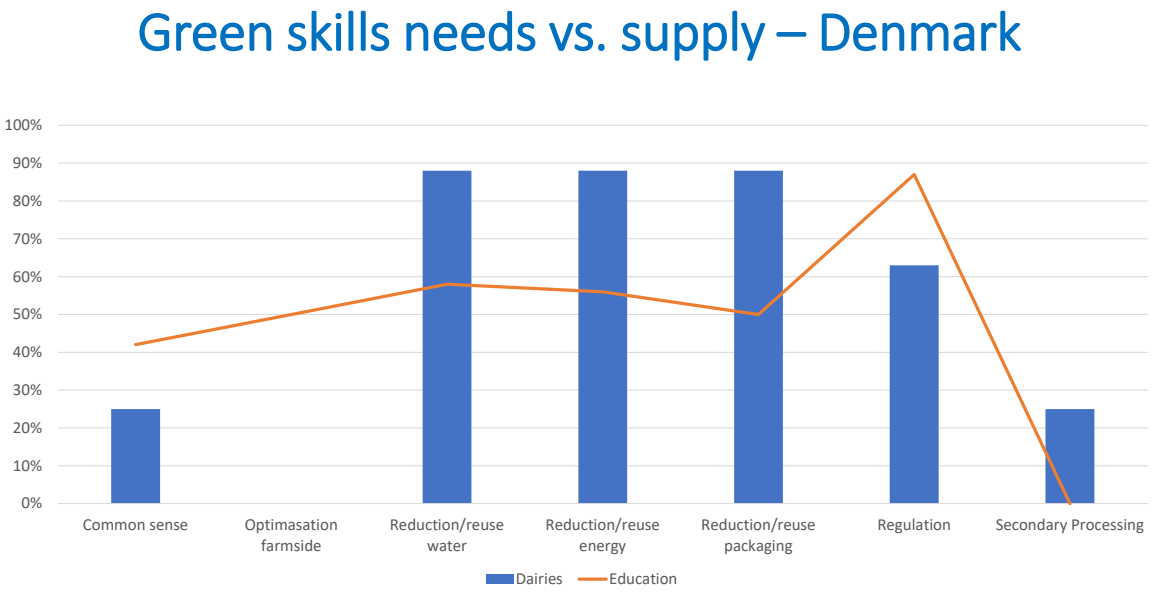

Figure 35. Green skill needs vs. supply in Denmark. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Denmark (orange line).

Green skills are of very high priority to the industry, especially in regard to better use of natural resources. In this regard, the focus is on all ends: reduction in loss of all waste streams, reuse of waste water in production, reduction in CO^2-emissions, cost efficiency and green business linked together, green optimization in packaging and the paperless dairy (which is also linked to the digital arena).

On the other hand, environmental policies (cooperate) and regulation (national and the EU) as ISO 14000 and not least: consumer expectations and competitiveness in an increasingly high demanding green agenda.

The green agenda has come to stay, and as such many interviewees regarded green skills as 'common sense'. The educational institutions at present are far behind on the green agenda as reflected above. Only in the teaching of regulation the schools seem to cover quite well, but when it comes to teaching in better use of water and energy, as well as more sustainable packaging, there is a significant gap between what the industry demands, and what the schools deliver. Respondents indicate by their answers, that teaching in the above should be boosted and even integrated as

cross-cutting in all relevant areas, like dairy skills generally, dairy processing, dairy technology, dairy cleaning and dairy material science. And then more specific teaching on environmental impact assessments, environmental risk assessments of future resource availability, improvement of climate resilience, technologies, products and processes to minimize carbon emissions. And specifically requested by the ex-students: *business models with green agenda should be at the core, as well as recycling in regard to packaging.* Moreover, the ex-students claim that green skills are requested in any dairy job position today.

These topics are either lacking from the educational curricula or not taught as green skills. At VET-level there is no focus on green skills - overall. The university college performs a little better, as does University of Copenhagen. None of them, however, focuses on 'secondary processing', which is requested by 25% of the dairies. Environmental regulation seems to be very well covered by the educational institutions - even more than requested by the industry, whereas the educational institutions teach an area that is not at all prioritized by the industry: optimization on the farm side.

As a general comment that very well covers what different respondents have answered with different wording, one claimed that green skills should become *'the soul of the dairies, just like quality and hygiene'*.

It should be noted that not all green skills should be covered by dairy employees. In the future there will be an increased demand for environmental engineers, plastic engineers, and other similar specialties, according to the qualitative answers.

Digital Skills

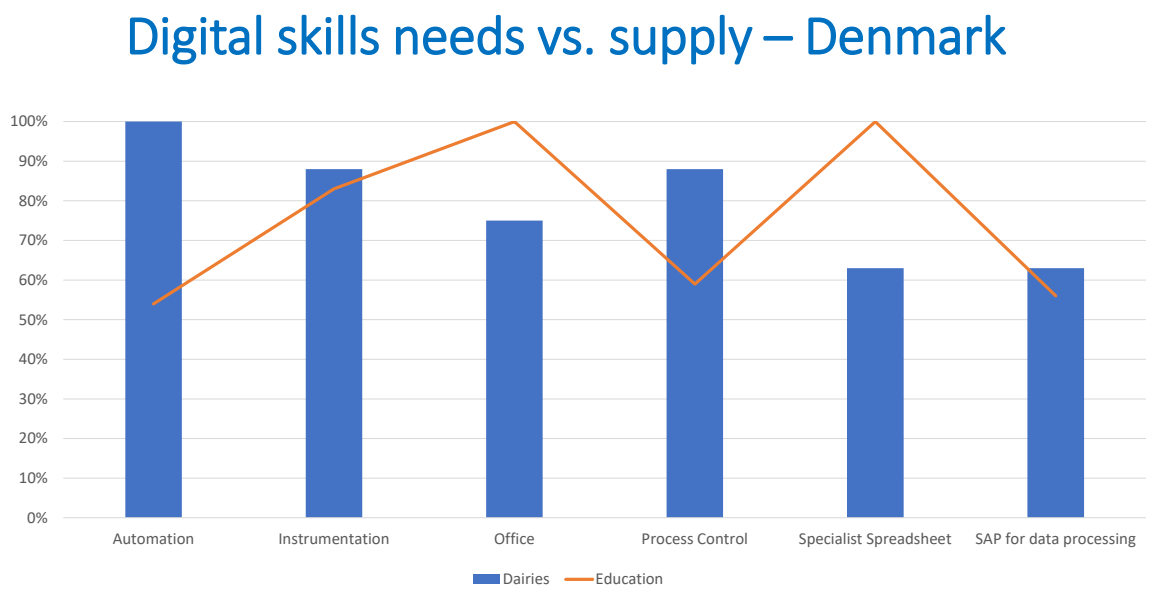

Figure 36. Digital skill needs vs. supply in Denmark. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Denmark (orange line).

Digital skills are generally highly demanded by the industry, but quite poorly covered by the educational institutions. In figure 36 the educational institutions score high on 'Office' and 'specialist spreadsheet' (100% which means that all three schools state to teach in all relevant topics). This is merely an indication that the schools expect the students to be well-versed in the Office-package when studying at a higher level. In regard to System Application & Product (SAP) for data processing, this area is not necessarily covered specifically, but the educational institutions like University of Copenhagen have courses including data processing and data analysis for similar system applications.

One of the areas where digital skills are highly demanded is automation (all dairies indicated to

have a need for upscaling digital skills in automation). At the same time, it is an area that is not very well covered by the dairy schools, as automation courses are available only in 50% of the schools interviewed.

Automation is big and all trends point towards it getting bigger. Nowadays it is almost impossible to work in a modern dairy without managing basic knowledge of robotics and digital process control. When asked which kind of digital skills are needed at the dairies, answers are very broad. It is everything from basic Microsoft-skills to decision making based on data analysis. As stated by one of the dairies: *'all registration is digital (stock, recipes, registration of stopping time, etc.)'* well on its way to the automated, paperless dairy.

Furthermore, the need to be more digital is also explained with cost improvements, process efficiency and product optimization (better quality and less waste). Moreover, when asked about the specific digital needs in the future, the dairies explain that new hardware is developed at a very high speed, which requires a high level of digital knowledge and continuous learning for employees. Also, online vigilance is increasingly being incorporated in the dairies, as well as automated process monitoring- and reporting systems. In addition, most of the processes are performed by robots, leaving digital management to humans.

Also, instrumentation is highly demanded by the dairies 88% of the interviewed dairies indicated to have a need for skilled people in this area. As regards instrumentation, the schools seem to cover this area pretty well.

According to graduates, digital skills are not well covered by the educational institutions. As mentioned by the ex-students: '*all job positions require digital skills at a much higher level than taught at school'*.

General remarks on dairy education

One major concern in regard to the digital and the green arena, is that teachers are not updated. Even when teachers have on-site training once a year to be updated on the newest technology and green improvements, it seems not to be enough.

Dairies were asked *'what should be improved in terms of training content and training methods in schools and universities'*. Some of the answers are reflected here.

Generally, there is a lack of overall complex understanding: how different processes affect other processes. Also, the ability of independent thinking is lacking and demanded by the dairies.

As regards automation, the students should have a better understanding of the rapid growth, hence ahead of what is needed to stay competitive. Moreover, they should have a better understanding of mechanical solutions as well as knowledge of new products. Further, these topics need to be taught also through hands-on experiences during the training.

The training material is too old-fashioned and in need of renewal: for example, in old books, where i.e. whey was considered a waste product, whereas today dairy innovations are often based on whey.

As regards teaching methods, there is mention of a need for more digital and differentiated teaching, interactive teaching, better use of technology in training, like for example YouTube movies of unit operations.

Furthermore, a recommendation to the schools from the dairies is for the teachers to spend more time in the dairy plants. Last but not least: it is imperative to implement better working conditions to retain the good teachers.

United Kingdom

In the United Kingdom 20 dairies (10 SME and 10 large) and four educational institutions, who all teach dairy were interviewed.

The UK Food and Drink manufacturing sector contributes some £20 billion to the UK's annual GDP. The sector employs an estimated 909,000 people. The sector, and particularly the dairy industry, has an image issue: there is little interest in wearing blue hairnets and white wellies in an environment surrounded by white walls and stainless-steel pipes. The impression, to most people, is that the dairy industry is connected to dairy farming and not to dairy manufacture and processing.

Some 80,000 people work in the UK dairy sector of which approximately 19,000 work on dairy farms. Of these 19,000, about 6,000 are paid labour (rather than family members) and around 33% come from Eastern Europe. Around 60,000 people work in dairy manufacture and processing, with 20% of EU origin.

It is estimated that the whole UK Food and Drink manufacturing sector will need 130,000 new recruits in 2024. Other industries, such as automotive, construction, aerospace and the service sectors, are also needing to recruit. This is a challenge post Brexit.

The role of the Industry and talent attraction plans

In 2008, the UK dairy industry, represented by six major dairy companies including Arla Foods, First Milk, Müller and Dairy Crest, joined forces with the National Skills Academy for Food and Drink, Dairy UK and Reaseheath College to create Project Eden. Project Eden resulted in a 3-year block release course for dairy specialist training within a modern 'training dairy', based at Reaseheath College. Eden is the only formal training specifically designed to deliver skills in the dairy industry.

A number of dairies have tried local initiatives such as full cost training, school tasters and apprenticeships to try and attract students into work to learn as they go, rather than a full-time experience in universities or colleges. The apprenticeship levy, which rolled out in April 2017, requires all companies who have a payroll of more than £3m in wages to contribute 0.5% of their overall salary bill into an independent levy fund, which employers can then access to finance apprenticeship schemes. Some of the key messages that have emerged present a clear challenge to the sector:

- *The demand for workers, both skilled and less skilled, currently exceeds supply.*
- *Within the existing workforce, roles including production workers, managers and the traditional craft sectors, have skills gaps. Overcoming the skills gaps is a continuing challenge for the industry.*
- *The poor image and profile of working in the industry hampers recruitment. In particular, there is a need to address the shortage of food scientists and technologists.*
- *An estimated 40% of the industry's workforce have qualifications that are relevant to their work, but large numbers of process operatives do not have any qualifications. Basic skills and personal attributes are of crucial importance for these workers.*
- *Smaller dairy manufacturing companies tend to need more help in identifying and meeting learning needs.*

Demands from the Dairy Industry

The dairy sector has been rationalizing and consolidating since deregulation in 1994. Up to then the industry was 'steered' by a national body, the Milk Marketing Board, and subsequently Milk Marque. Whilst concentrating on rationalization the industry relied on its existing workforce to maintain and update skills and knowledge. However, with an ageing workforce, and workers leaving/retiring, there is a significant knowledge/experience gap. The sector continues to experience reductions in capacity, mergers and acquisitions, rapid technological and operational change, and changing customer requirements.

The sector now comprises a number of large multi-national companies offering wide product ranges, and very many SMEs. The major supermarkets are the important customers for the large firms while many of the smaller companies are meeting the demands of specialist or niche markets. Benchmarking evidence suggests that the sector is already comparatively efficient when compared to Europe as a whole. The sector employs nearly 40,000 people in milk processing, manufacture, and distribution occupations.

The supply of employees for the dairy sector is lower than the demand; this is consistent with the general skills supply in the UK.

At higher levels, the current workforce is less well qualified than the average of the UK population. However, at greater proportion of dairy employees are qualified to level 2, or its equivalent (more than the average of the UK population). In the better qualified sub-sectors of the industry, around 40% of the workforce have formal qualifications that relate to their jobs. However, a third of process operatives have no qualifications at all.

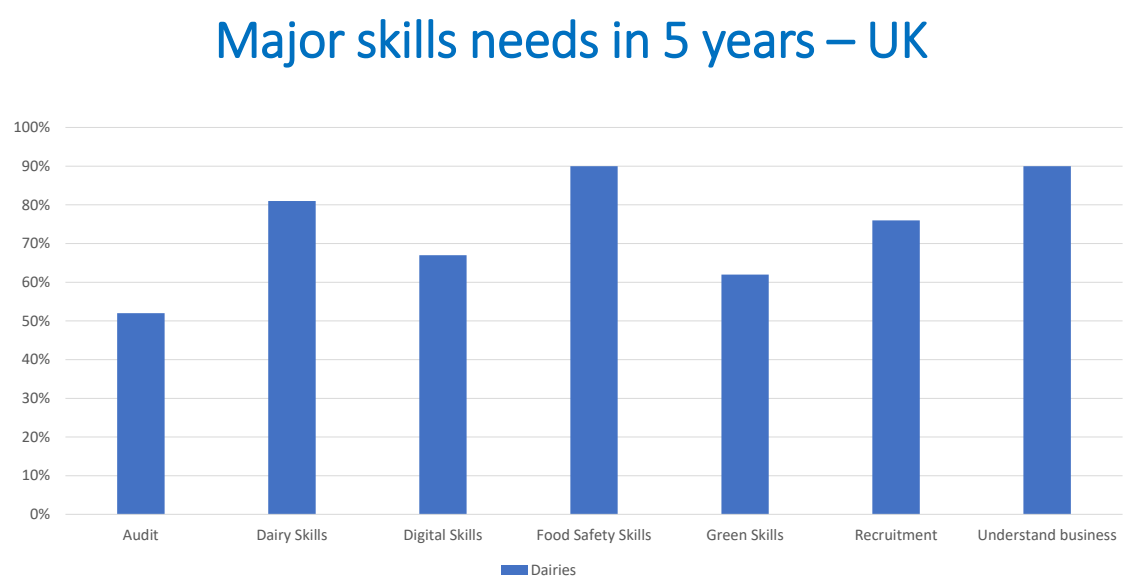

Figure 37. Major skill needs in 5 years in the UK based on the 7 categories which scored most need overall.

Gaps

Skills shortages - the problems

Widespread skill shortages have been reported, especially among the more highly skilled occupations. Employers report that skill shortages lead to increased operating costs, difficulties in meeting customers' needs and problems in introducing new working practices that would increase profits.

Outside the main topics associated with technical training, 'understanding the business' and 'recruitment' have significant importance.

'Understanding the business', at 90%, is significant. Employees should understand the needs and wants of the customer and consumer and for that they need to understand some basic business working and concepts. This may be service, it may be costs, it may be attainment etc. It is not enough to just turn up to work.

Some of the most important skills gaps in dairy manufacturing where 'understanding the business' which includes

- *basic and key skills e.g. communication and team working;*
- *technical and practical skills;*
- *vocational knowledge;*
- *generic management skills;*
- *IT skills among skilled workers;*
- *personal attributes and attitudes.*

Work ethic and apathy about the job are a cause for concern and indicate that overcoming the skills gaps will continue to be a major trial for the attraction of future workers.

Skill gaps can prevent/hinder a dairy business from achieving its objectives and strategic goals including:

- *loss of business to competitors, reductions in customer care and quality of work, and increased operating costs.*
- *high levels of staff turnover.*

Many of the larger employers tackle these problems, often quite successfully, but a significant proportion of employers openly admit to taking no action.

Issues arising from these skill gaps

Qualification levels are low throughout the industry. The reasons are failures to train, lack of interest and concerns over relevance of qualifications, public funding of lower level qualifications for adults, and the need for 'academic', vocational and basic skills qualifications.

The low commitment to Apprenticeships is a serious issue. Companies quote concerns as:

- *Lost productivity due to 20% off job training*
- *Financial resources (although mitigated by the apprenticeship levy).*
- *Availability of suitable candidates*

Personal attributes of employees, such as a work ethic and an interest in the job, underlie the ability to develop skills. The fact that these attributes are a cause for concern in many parts of the dairy industry suggests that overcoming the skill gaps will continue to be a major challenge.

Skills mismatches, shortages and gaps can often be much more harmful in SMEs because they have a proportionally greater impact.

There is a noticeable difference in the general needs between large and smaller manufactures. Larger companies demand all skills now and, in the future, where smaller companies recognize the need to develop within their own company.

Other high-ranking topics

Few education suppliers are meeting the needs now or indeed little hope of meeting those challenges in the future. In general, the larger dairies will train and develop their own staff in key leadership and management skills. Lean, Food Safety equipment engineering and maintenance, Filling and packing and Dairy Science seem to be adequate for the purpose needed as 'entry level'' in the industry where the education is available as demanded.

However, in contrast: Food Safety Hygiene, Process & Product, Product Technology and Dairy Processing provision by the educators fall well short of industry expectations.

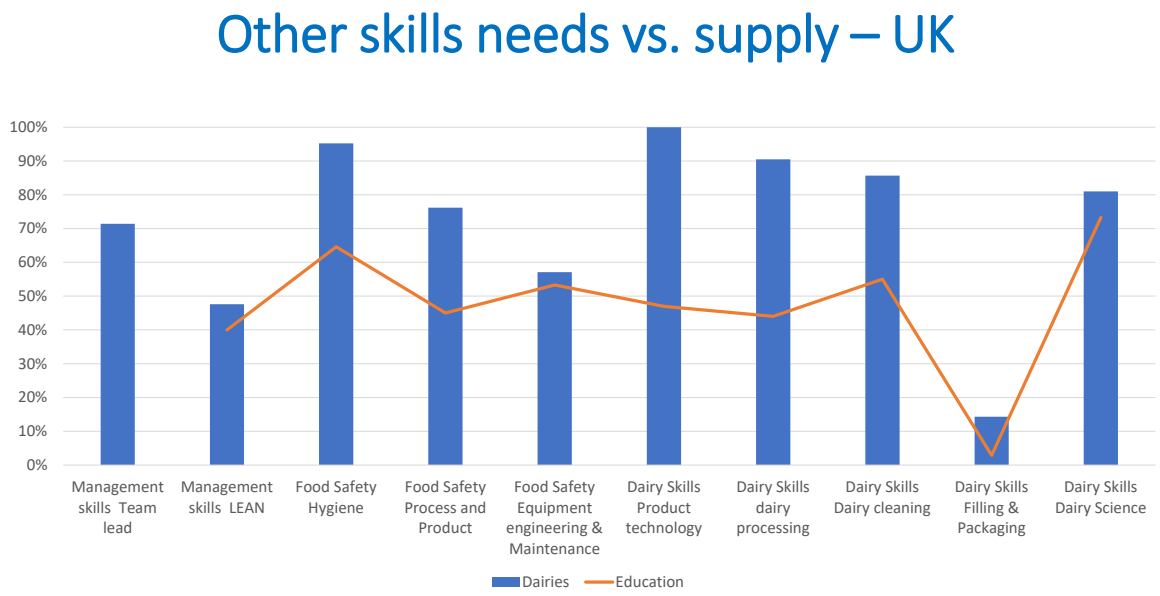

Figure 38. Other major skill needs vs. supply in the UK. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in the UK (orange line).

Changes in dairy manufacturing (changing skill needs)

The changes that have taken place in the dairy sector is typical of wider change taking place throughout food and drink manufacturing. Recent Employer Skills Surveys demonstrated that, in a cross section of vigorous and proactive food manufacturing companies, the drivers of change are:

- *competitive pressures;*
- *changing patterns of consumer demand;*
- *regulation;*
- *internal drivers such as changes in ownership, strategy or management.*

These drivers are applicable in all sub-sectors of the industry, but it is the increasing use of technology and, in some cases, the development of new working practices that allows the change to take place.

Literacy skills

Many generic skills have been identified as essential to the dairy sector's success. For example, in addition to strong and effective communication skills that are essential in managers and team leaders, it is imperative that operatives possess basic literacy skills that enable them to cope with product labelling, basic record keeping and communications in their work groups. This requirement will grow as numbers decrease and more complex jobs develop, especially in process control, automation and enhancements to human performance/robots.
Other generic skills required are:

- *numeracy;*
- *IT and computing;*
- *team working;*
- *taking responsibility;*

- *problem solving;*
- *an interest in training and development;*
- *an ability to cope with change.*

Personal attributes

A positive work ethic and an interest in the job are often identified as attributes that are lacking and it is clear that these underpin the ability to perform at any level in the industry. Personal attitudes and attributes underpin the ability to perform the most basic tasks and to learn the vocational skills and knowledge required in the more highly skilled occupations.

Vocational skills

The vocational skills and knowledge needed include:

- *food hygiene;*
- *health and safety;*
- *understanding quality;*
- *understanding the business;*
- *breadth of skill to facilitate flexibility;*
- *maintenance skills and multi-skilling;*
- *manual skills and dexterity.*

There is a tradition of multi-skilling in some dairy manufacturing where workers are skilled in both production and minor engineering roles such as Asset Care (AC) where there are signs that production workers are sometimes being required to develop machinery operation and maintenance skills in addition to their more traditional manual skills. This is not reflected in learning at education establishments.

Green Skills

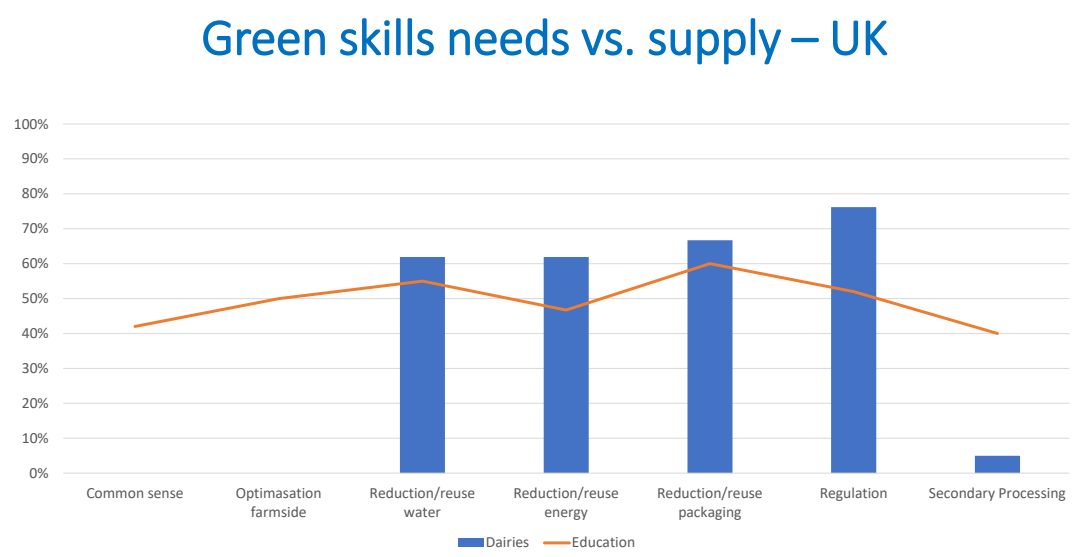

Figure 39. Green skill needs vs. supply in the UK. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in the UK (orange line).

The economic changes needed to tackle these problems must be a development of a whole green economy that will affect all business sectors. This is true for all industries connected to dairy: dairy manufacture, logistics, administration, plastics, and energy use. This will entail a sectoral shift.

Government legislation, public pressure and strong business reasons will and are driving the dairy industry to react. With newer factory builds this green awareness can be 'built in' to the factory infrastructure, process and effluent handling. However, many dairies in the UK are many years old and are expensive to upgrade to meet the challenges of the now and the future.

Much of the UK data is based on Green Businesses, wind, solar and electric, but we must address the skills needed to produce green awareness in employees now and in the future.

The transition to a green dairy supply chain requires a workforce with the right mix of skills. There is clear recognition by the UK Government and the dairy industry that tackling climate change, securing future energy supplies and making a permanent transition to a low carbon, high growth economy is an urgent and vital task. This is generally coordinated by the industry trade body, DAIRY UK.

UK data, separate to this survey, indicates that, in general, businesses find difficulty in articulating their future green skills needs.

In 2008 the Dairy Industry was steered by the DAIRY UK Road map which celebrated 10 years in 2018. *"..the British dairy sector has reported a marked improvement in its environmental footprint, not only reducing the emission of greenhouse gases, waste, and other pollutants but also improving the efficiency at which it consumes water, energy, and other resources. Crucially the Dairy Roadmap recognizes that there is no endpoint to environmental sustainability, and led by Dairy UK, the NFU, and AHDB the entire supply chain continues to set ambitious targets for improvement that draw from the ever-changing sustainability agenda. In 2017 the Dairy Roadmap signed the Dairy Declaration of Rotterdam, and in doing so recognized the role that the dairy industry can play in the delivery of the UN Sustainable Development Goals. Domestically, we work closely with a number of stakeholders such as Red Tractor and WRAP to maintain and develop environmental standards, and through the ambitious targets of the Dairy Roadmap have set strong foundations to help deliver the government's 25 Year Environment Plan." (Dairy UK 20128)*

The Green skills demand

The data for Green Skills indicates that education has some alignment with industry when delivering Green Skills but falls short in all the sections and particularly regulation demanded by 75% of dairies questioned. Figure 40 below, less legislation and benefits suggest this alignment has good inroads to the skills required.

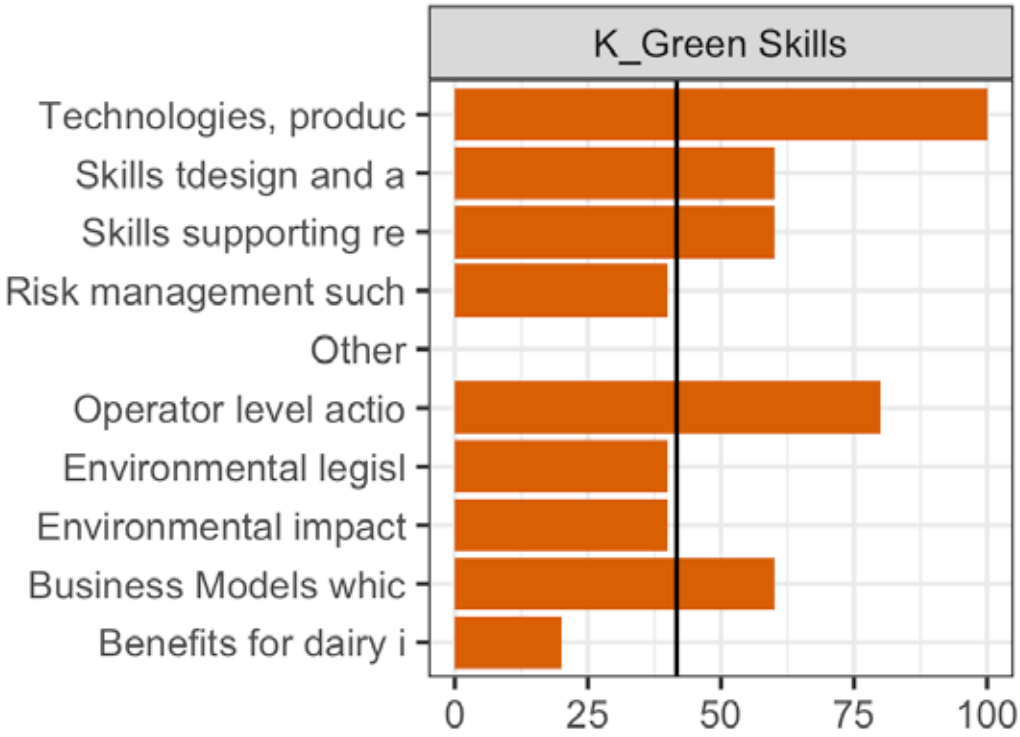

Figure 40. Percentage of topics provided by educational institutions within Green Skills

Digital Skills

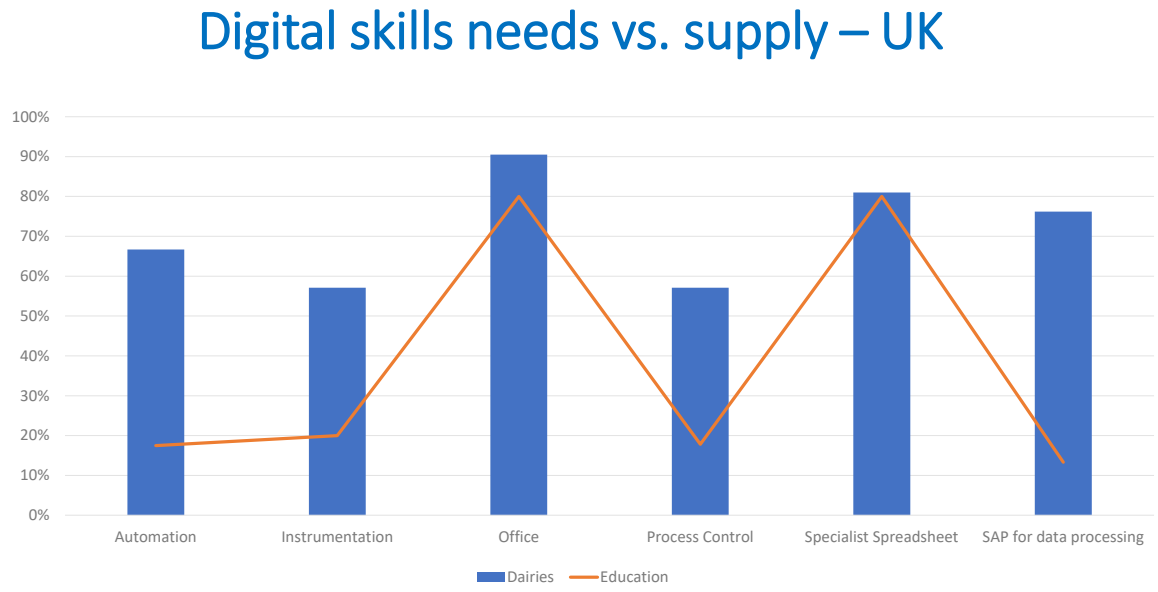

Figure 41. Digital skill needs vs. supply in the UK. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in the UK (orange line).

Digital technologies, Artificial Intelligence (AI) and **automation** are often spoken of as a potential replacement for this gap, with the increased efficiency and accuracy of technological solutions compensating for the loss of a portion of the physical workforce. However, in parallel many Human Resources (HR) departments underestimate just what is required of them to make the most of technological progress, by way of re-training and up-skilling their incumbent workforce, as well as adapting their hiring processes to foster new, digitally savvy, talent. This is reflected in the dairy education survey where there are sufficient generic digital skills, such as Office packages, but much less in 'applied' fields (Process control, robots, programming, fault finding using digital hardware, automation etc.) where there are huge gaps in knowledge amongst engineers, technologists and operators including statistical manipulation of big data (SAP) produced by a digital factory.

Ireland

It is important to note that the scope of this survey relates primarily to the milk processing operations part of the supply chain and does not attempt to address corporate functions such as finance, procurement, international sales & marketing, HR etc.

Some background information on the provision of dairy education in Ireland may provide some context that could be helpful to interpreting the result of this survey. A Faculty of Dairy Science was established at University College Cork (UCC) in 1925 and UCC went on to become the centre for the education of Operations and Technical managers for the industry in Ireland for over 60 years; offering a two-year Diploma in Dairying (Creamery Managers' Course) and a four-year BSc. (Dairying) degree. Only holders of these qualifications were eligible under dairy legislation to hold the post of creamery manager.

Although the skilled role and contribution of well-trained Buttermakers and Cheesemakers to the efficiency and quality of the Irish dairy products during the early to mid-twentieth century is well recognized, the training they received has not been well documented in the annals of the Irish dairy industry. It would appear that "on the job" training under the supervision of a qualified creamery manager was combined with practical training courses approved & validated by the Dairy Produce Division of the Department of Agriculture.

A major "rationalization" of the Irish Dairy Industry started during the 1960s and 1970s involving the amalgamation of small co-operative creameries and the establishment of "central" processing sites. With the 'industrialization" of the industry from 1960 onwards the role of buttermakers and cheesemakers was gradually replaced by production supervisory staff (usually with a dairy science diploma or degree) supported by laboratory technicians with third level certificates or diplomas from

newly founded Technical Colleges.

During the 1970s and 1980s a gradual conversion from “Dairy” to “Food” evolved within academic institutions and in 1990 the UCC degree course was renamed BSc. (Food Science & Technology) and the Diploma in Dairying course was discontinued in 1991. Segmentation of the degree programme followed into several more delineated “Food” degrees (Food Science, Nutritional Science, Food Engineering, Food Technology, Food Business). Food Science degree programmes emerged from the Faculty of Agriculture in University College Dublin (UCD) and from the Life Sciences Faculty at the University of Limerick (UL). A Food Industry Training Unit was established at UCC in the 1990s to deliver lifelong learning and support the continuous professional development of staff in the food industry and in 2017 a Post Graduate Certificate in Dairy Technology and Innovation (Level 9), based on a blended-learning model became the first specific dairy qualification to be created in decades.

A related feature of the development of the University sector over the past three decades has been a major increase in externally funded food research, particularly under targeted, publicly funded, national research programmes and EU research programmes. This greatly increased the supply of graduates specifically trained for Research & Development. A perhaps unintended consequence of this emphasis on academic research was a shift in emphasis from technological research to nutrition & health topics based on developments in molecular biology. Time managing large and often collaborative research programmes also competed with teaching time in the working week of some faculty members.

From the 1980s production staff training became a recognized function of corporate Personnel Departments and Work Placement (which was always a requirement of the Dairy Science courses at UCC but only incorporated into the academic year in 1995) became a feature of courses targeting the Food Industry. Practical training courses in aspects of dairy technology were also developed and delivered at the Moorepark Dairy Research Centre and accredited by the national Industrial Training Authority to meet the growing demand from dairy companies. Personnel departments evolved into Human Resources departments and put in place their own Graduate Training Programmes to formalize the transition from academia to the workplace and address the particular skills gaps of new entrants to their business. Universities, State Bodies, Professional Bodies and independent training companies also provide specialized training to dairy companies, particularly in areas such as Quality Management, Occupational Health & Safety and Lean Manufacturing.

Today, four companies (Glanbia, Lakeland, Dairygold and Kerry) together process approx. 80% of the milk supply in Ireland. A 50% increase in milk production has taken place since the abolition of milk quotas in April 2015 and almost €1 billion has been invested in processing capacity over the past decade. This expansion in milk processing combined with the retirement of experienced staff has fueled an increased demand for “work ready” new entrants to the dairy industry in all roles and levels.

Demands from the Industry

By selected topic

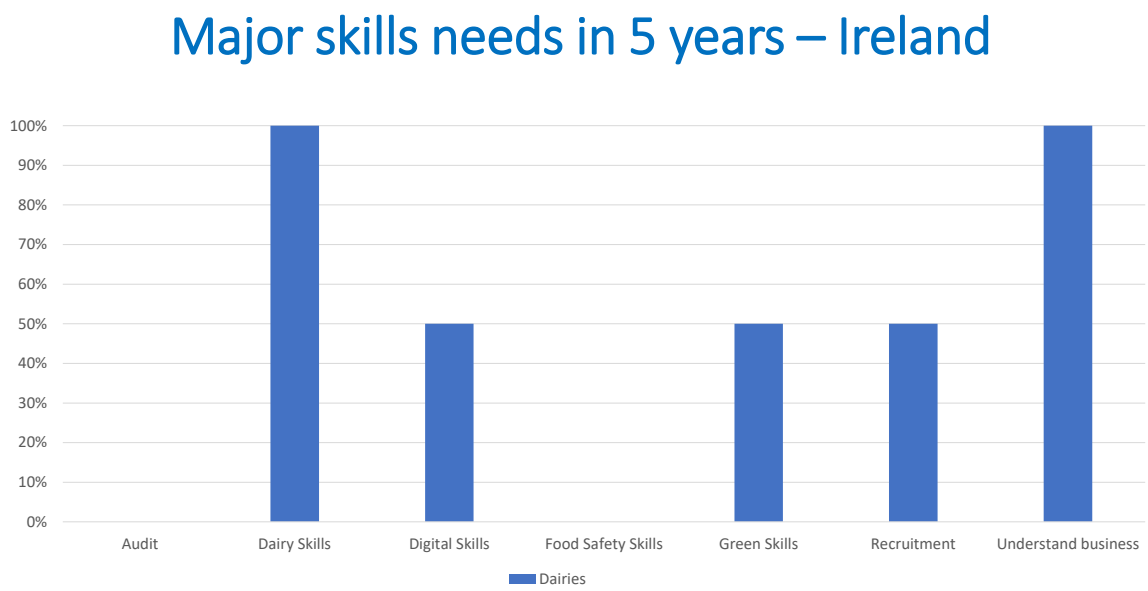

Figure 42. Major skill needs in 5 years in Ireland based on the 7 categories which scored most need overall.

Given the diverse range of educational backgrounds & levels of achievement and academic technical disciplines found in factories and the wider supply chain today, it is not surprising that fundamental dairy skills (knowledge of milk production, assembly, composition, microbiology, physico-chemical properties of milk constituents and the effect of unit operations in milk processing & preservation on the quality & stability of dairy products in their respective supply chains) and a knowledge of the dynamics of the business (from perishable raw materials & products to supply chain economics, lean manufacturing. markets & their expectations, consumer insights and the functioning of the retail sector) emerged as two common denominators. That combination of individual competences together with an understanding of what those around you are doing is a prerequisite for effective communication and organization of any workplace.

Food safety

Food Safety Management & Audit, which would have been identified as high priority areas in the past are now embedded in the operation & ethos of milk processing plants to the extent that they hardly attract attention in this survey.

Recruitment

Recruitment of young people into the food industry is a persistent issue and is acutely so for some skill sets in the face of competition from particularly the Bio-processing and ICT sectors which feature strongly in the Irish Economy. There appears to be a low level of interest among millennials in the food industry. When millennials think of the food industry, food manufacturing is often a blind spot – they think of food service (flipping burgers or waiting tables). It seems that unless someone is from a farm family, had a parent who worked in the food sector or something in school inspired a young person to pursue food science, the industry is not on most young people's radar. They do not know about all the different jobs available, and neither do most career and guidance counselors. The Dairy Industry has not done a great job of promoting themselves as good companies to work for, compa-

red with the likes of Google, Facebook and other big tech companies and to promote themselves as good employers that are exciting and fun to work for.

High speed digital development

Because, in general, the profit margins in milk processing are low, the drive for competitiveness over several decades has focused on scale and automation. Computerized Enterprise Resource Management, Process Control and Quality Control systems are standard in the industry and constantly evolving in complexity and capability. Adoption of advances in wireless devices (e.g. smart sensors, mobile devices & wearables), high speed networking & data management and artificial intelligence--based software will continue to have a major impact on factory operation (Industry 4.0). Thus, digital literacy is essential across all roles and the need for skill development is relentless.

Green adaptation

Because of the large scale of modern milk processing plants, frequent location in environmentally sensitive rural areas and the high strength of dairy wastewaters the industry has attracted a high level of Environmental Regulation and monitoring over several decades. The industry has invested heavily in sophisticated biological treatment systems with primary, secondary and tertiary stages.

In combination with the focus on waste minimization, coming from the adoption of Lean Manufacturing systems, a high level of communication and understanding between process and environmental personnel is essential in order to meet the stringent terms of Environmental Licenses. The introduction and enforcement of binding Climate Control measures for the industry in recent years has added greatly to the Environmental Compliance workload plus a high level of engagement with regulators the retail sector and consumers. Thus, green skills are a pre-requisite across all sectors of the industry.

Gaps

By other high-ranking topics

These topics are compared to the overall educational supply from the educational institutions, demonstrating clearly the gaps.

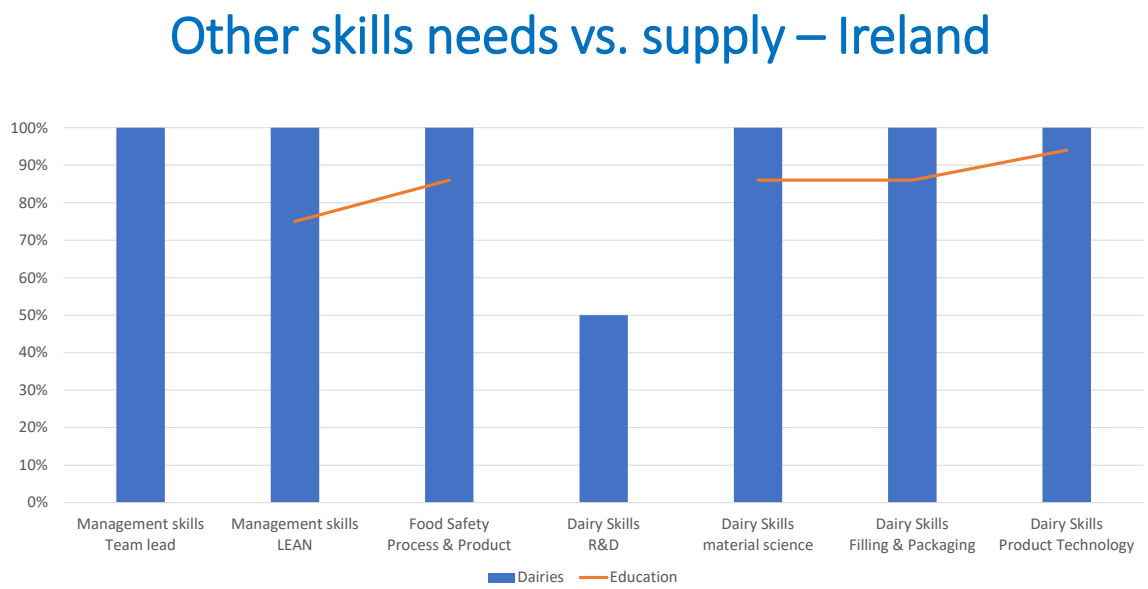

Figure 43. Other major skill needs vs. supply in Ireland. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Ireland (orange line).

Management skills are not among the deliverables expected from Educational Institutions, at least not in the case of science, engineering & technology courses. HR personnel and line managers would of course screen for attitude and personality traits indicative of management & leadership potential at recruitment, during the probationary periods and during routine staff performance evaluation. The development of management skills is regarded as the responsibility of both the individual and the company.

Curiously, despite an increase in the number of entrants to the industry who have completed post-graduate research training, R&D skills (such as literature searching & review, statistical design & execution of experiments, the analysis of data and scientific writing skills) do not appear to be recognized as skills acquired during education.

In general, other high-ranking topics such as Lean Manufacturing, Process & Product related aspects of Food Safety, the science of milk & dairy products and Packaging Technology are regarded as being well covered (80%) during formal education.

Green Skills

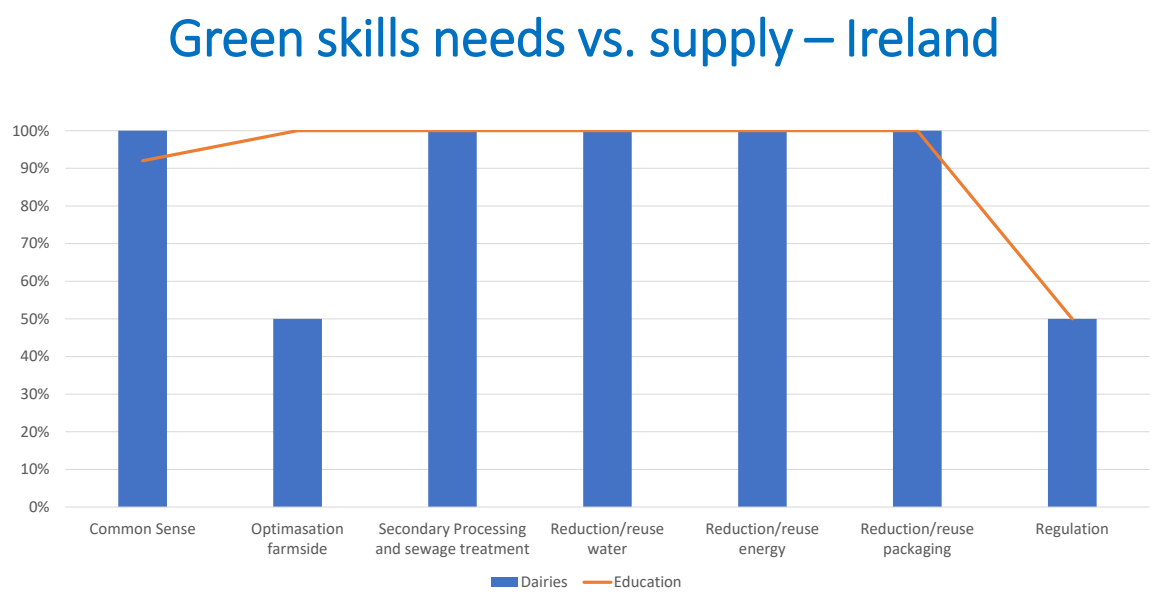

Figure 44. Green skill needs vs. supply in Ireland. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Ireland (orange line).

Food Wise 2025, the national strategy for the development of agriculture & the food industry in Ireland emphasizes the key importance of sustainability and points out that economic competitiveness and environmental sustainability are equal and complementary needs to be embedded at all levels. Sustainability is tackled at a global level in the dairy industry through the International Dairy Federation action programmes. In Ireland, where milk production from grass on small scale family farms is the norm, sustainability is viewed as a potential competitive advantage in the marketing of Irish dairy products and national programmes, such as Origin Green which is administered by the Irish Food Board (An Bord Bia) have been developed to promote sustainability from farm to fork.

It is comforting to note the high level of achievement by the educators in relation to specific topics such as the reduction / reuse of energy, water & packaging and secondary processing / wastewater treatment and common-sense approaches to control.

Across the board it would appear that regulatory measures to be applied to implement national commitments on climate change policy are not well understood at operational level and regarded as

an area for engagement by senior management of industry collectively. The 50% score for farmside optimization is unexpected given the amount of resources being deployed on measures to mitigate GHG contributions at farm level – it may simply reflect a view that this is a big issue but outside the scope of operations personnel, who need to focus on the considerable in-plant issues on the horizon.

Digital Skills

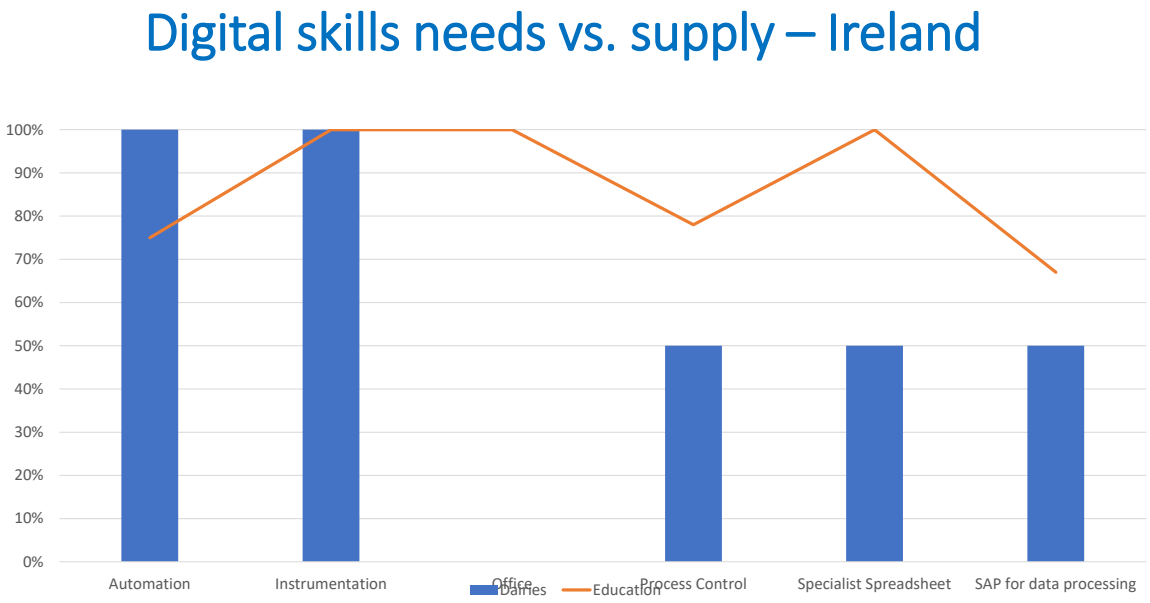

Figure 45 Digital skill needs vs. supply in Ireland. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Ireland (orange line).

Automation and Instrumentation are identified as the two priority knowledge provision areas among digital skills. This is not a surprise given the focus of the Irish Dairy industry on the efficient production of a narrow range of consumer products and ingredients at scale. There appears to be general satisfaction (>75%) with generic knowledge provision on instrumentation and automation as well as generic data manipulation & spreadsheet-based analysis.

Enterprise Resource Management software-based management systems, such as SAP, are now embedded in the industry and maintained & managed at corporate level. One possible exception is the conversion of Preventative Maintenance and Engineering Records over to SAP, which appears to be happening at a slower pace.

Of some concern is the 50% score for Process Control, considering the developments taking place in Predictive Process Controls, Neural Networks, Artificial Intelligence and Augmented Reality which will have on the ground application impacts in the next five years.

General Comments

In 2015, Food Wise 2025, a 10-year vision for the Irish Agri-Food Industry was published setting out ambitious targets for the development of the food industry and identifying priority actions needed to enable the realization of these targets, which included investment in human capital.

An Expert Group on Future Skills Needs for the Food & Drink Sector in Ireland, followed up in 2017 with the publication of a review carried out by the group.

The analysis and consultations undertaken as part of the review indicated particular skills requirements giving rise to issues for manufacturers in the sector across three distinct levels:

1. *Operatives and production level, where there was a considerable need for literacy, numeracy and basic ICT training, hygiene and HACCP training, as well as some specific areas including craft skills.*
2. *Middle management where there continues to be a need for lean production, supply--chain management, business strategy, marketing and other management skills.*
3. *Senior management where there are gaps in succession planning, new product development and internationalization skills.*

Among the key recommendations set out in the review were:
Work-based learning

- *Greater accessibility of courses on numeracy, literacy and basic ICT skills;*
- *Incentives to support firms releasing staff for training;*
- *Developing and promoting additional skills and training options for middle management and succession planning.*

Internships, Mentoring & Apprenticeships:

- *Establishing a 2-year mentorship programme focused on SMEs;*
- *Organize a Millennials focus group to better understand how to attract and retain graduates*
- *Increasing industry participation in food and beverage sector relevant apprenticeships programmes*

Three coordinating actions were identified on the implementation side:

1. *An annual stakeholder forum*
2. *A One Stop Shop website to provide information on training available.*
3. *Implementation monitoring & impact assessment*

Turkey

The research in Turkey was conducted in 23 Turkish dairies in different sizes (9 large, 5 medium and 9 small dairies). Among these dairies, there are 17 butter producers, 20 cheese producers, 18 dairies that produce fermented milk products, one dairy that produces ice cream and 12 produce drinking milk and five dairies produce milk powder and dairy ingredients.

The research was made in seven different educational institutions that have dairy science and technology departments or programmes. In the research phase, 25 questionnaires were applied to ex-students.

Green skills were determined as the major skill need with 96 % of respondents affirming it to be of imperative importance. Green skills were followed by digital skills (78 %), recruitment (70 %), dairy skills and food safety skills (52 %) and understand business (13 %). No significant demand was registered in regard to audit.

When the plant size was evaluated, digital skills were found as the most important skill needs to be developed in the 5 years. Digital skills are going to be more needed in the small size plants. On the other hand, if the plant size increases, the need for food safety decreases. Because, the bigger size dairies are more capable of conducting applications and operations on food safety. The operational and recruitment capabilities of the large dairies are higher, as they have better capacity to attract qualified labour force.

Demands from the Industry

By selected topic

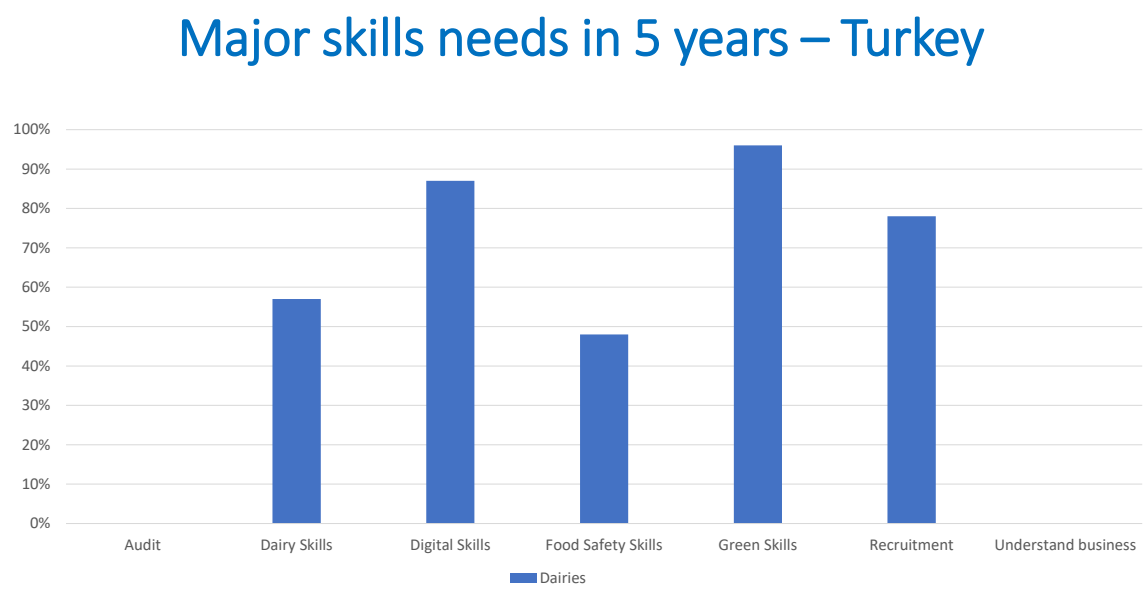

Figure 46. Major skill needs in 5 years in Turkey based on the 7 categories which scored most need overall.

In Turkey, green skills were determined as the most vital need in the next five years. This was followed by digital skills (87 %), recruitment (78 %), dairy skills (57 %) and food safety skills (48 %), respectively. No significant demand was observed on audit and understanding business in terms of dairies.

On the other hand, the topic “filling and packaging” among dairy skills was found as a main priority by the educational institutions. This was followed by lean management skills, dairy materials skills, R&D skills and team lead skills in the management skills.

Among the green skills reduction/reuse of packaging was found to be a significant need, whereas automation was the most significant need among the digital skills.

When the plant size becomes smaller, the need for digital skills, green skills and food safety skills increase. Whereas, needs related to the recruitment changed inversely compared to the plant size. The recruitment challenge decreased when the plant size increased.

In general, when the plant size is considered in terms of major current and future needs, green skills were most important in both. In the future perspective, the needs related to food safety and understand business decreased slightly, while the needs regarded to dairy skills, digital skills and recruitment increased.

Especially, demands to dairy skills, digital skills and recruitment increase in large dairies in the future. The skill needs for food safety kept its importance at the same level in the future while the needs regarding to green skills and understand business decreased in the large dairies.

The needs concerning digital skills and recruitment increase, while dairy skills, green skills and understand business are constant for medium size dairies in the future. The food safety skills were foreseen to decrease for medium size dairies in the future. In terms of small size dairy plants, dairy skills, digital skills, food safety skills and recruitment needs will be expected to keep their importance at the same level. The green skill needs increase while understand business decreases for the small size dairies in the future.

If the skill needs were compared between the current situation and future according to the product type, green skills will stay on the top of importance compared to the other skills need. However,

the skill needs including digital skills, dairy skills and recruitment increased in the dairy plants which produce butter, cheese, and fermented milk products. Food safety skills declined in the dairies which process butter and cheese, while it ascended in the plants producing drinking milk and milk powder/ dairy ingredients in the future.

Gaps

By other high-ranking topics

These topics are compared to the overall educational supply from the educational institutions, demonstrating clearly the gaps.

Generally, in terms of dairy plants and educational institutions, green skills and digital skills are of substantial need in the future. The main skill needs to be developed in the future in the educational institutions are dairy skills, food safety skills and audit.

Automation (91.3 %) among the digital skills for the dairy sector and filling and packaging by educational institutions were declared as the most significant needs/challenges.

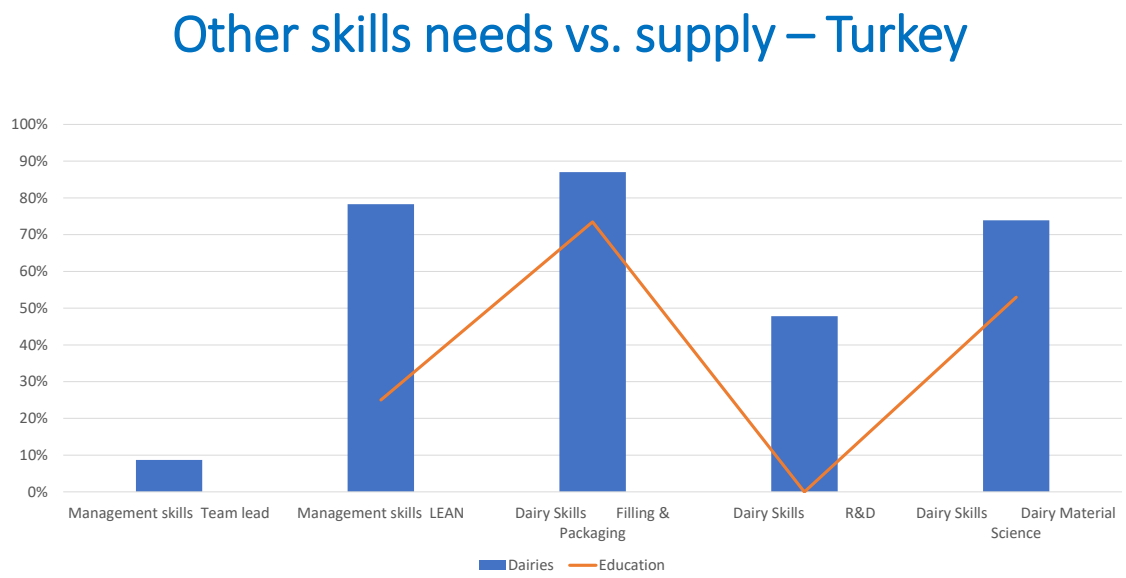

Figure 47. Other major skill needs vs. supply in Turkey. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Turkey (orange line).

Country based future gaps

Automation skills were determined as a substantial need for the future with 91 %. Consecutively, this was followed by the filling and packaging skills at 87 %, reuse water/reuse energy needs at 83 % and continuous improvement at 78 %.

When the dairy skill needs were divided into sub-groups, the most requested were skills within dairy material science, filling and packaging and Research & Development.

In terms of the skills needed to ensure food safety, the most prevalent were knowledge about equipment engineering and maintenance, as well as management systems, and process & product skills.

In terms of management skills, the skills related to continuous improvement by lean behaviours, lean skills and the skills related to corporate, environment and social responsibility were stated to be most important, together with team management skills.

Green Skills

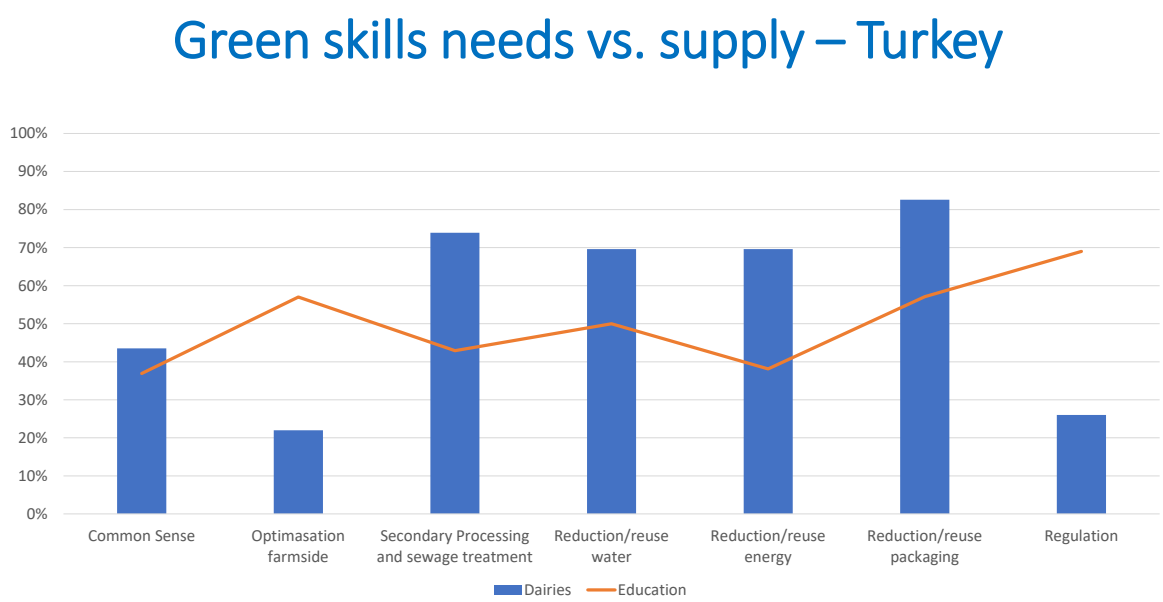

Figure 48. Green skill needs vs. supply in Turkey. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Turkey (orange line).

When the sub-groups of green skills were considered, the needs regarding reduction/reuse of energy, reduction/reuse of packaging, reduction/reuse of water, regulation, secondary processing and sewage treatment needs are going to decrease in the future.

As an answer to the question “green skills why”, the natural resources were found as the most significant explanation.

When the green skill needs at dairy plants were contemplated, “natural resources” was found to be the main need for all dairies in parallel to other countries. The need for “spreadsheet” within digital skills was mentioned as the main gap by the seven Turkish educational institutions.

Digital Skills

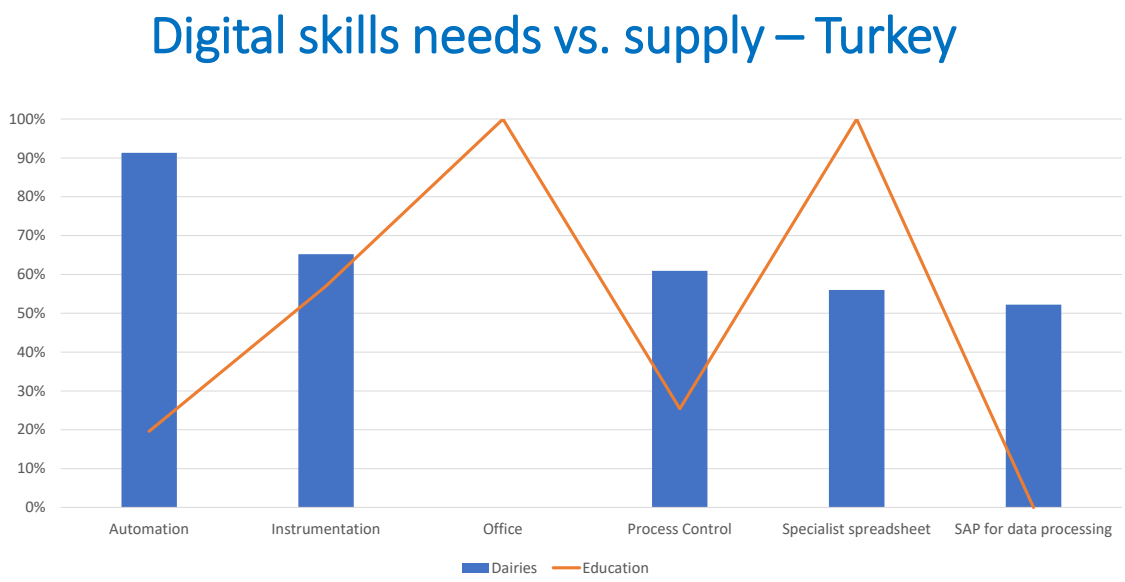

Figure 49 Digital skill needs vs. supply in Turkey. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Turkey (orange line).

Generally, the greatest gaps in regard to digital skills were found within the fields of automation, process control and SAP for data processing. In regard to automation the gap is stated at 70 %, in regard to SAP for data processing, a gap of 50 % was detected and with regard to process control, a gap of 35 % was determined.

Sweden

In Sweden, eight dairies were interviewed (seven large dairies and one SME). No educational institutions were interviewed as Sweden only offers short dairy courses. However, at Lund University, two dairy courses (three weeks/course) are given yearly in close cooperation with the dairy industry and processing and packaging industry. The aim is to give the participants deep knowledge of dairy technology and dairy processing with the two courses in the programme: Dairy Technology (7.5 ECTS) and Dairy Processing (7.5 ECTS). The course Dairy Technology aims to provide a scientific background and fundamental knowledge of milk from a chemical, physical and microbial point of view as well as an introduction to processes in the dairy industry. The course Dairy Processing aims to provide a scientific background and fundamental knowledge of traditional and new technological processes within the dairy industry. The courses are offered both for participants from the industry as well as for students within the MSc in Engineering programmes, Biotechnology and Chemical Engineering at Lund University and Master programme in Food Technology and Nutrition at Lund University. For longer educations, people with interest in dairy go to Denmark to be educated either at Kold College, University College Lillebælt or Copenhagen University. The data from the research conducted in Sweden is therefore compared to the educational levels from those three Danish educational institutions.

Historical view on Swedish Dairy Education

The extent and development of dairy education in Sweden has decreased over years. Alnarp had an extensive dairy education and also a dairy engineer education, both of them stopped in the sixties. During 1980-2000, trials were executed to start up new dairy educations, but without success.

The dairy industry executed dairy educations on Caseum in Falkenberg until 2006. In connection with the closure of Caseum, trials were carried out to transfer the educations to Kold College in Denmark. Swedish dairy teachers worked at Kold College, but the arrangement was not sustainable. During the latest years, basic education in the dairy area has been modest.

Today new trials are implemented to vitalize the dairy educations in Sweden in co-operation with Kold College. Head of the educations are Arla Food, Skånemejerier and Norrmejerier. Lernia is the education coordinator. The education consists of basic educations, branch courses and Dairy Technology Education.

On the level for universities dairy education started at Lund University in the 80s. The education contains Dairy Technology and Dairy Processing, and are executed with support from Arla Foods, Skånemejerier, Norrmejerier, LRF Mjölk and Tetra Pak.

Demands from the Industry

Within Sweden, indeed closely reflected across the EU surveyed dairies, there were recurring themes. The top issue remains the availability of Trained Dairy Technologists where there is a distinct lack of skills and knowledge as well as availability (Recruitment and Retention). Notably now and in the future there is a distinct need for:

1. *Dairy Science*
2. *Dairy Product (especially cheese)*
3. *Processing Skills/Knowledge including packaging*
4. *Food safety including HACCP*
5. *Quality*

Sweden is dependent on formal training from Kold college as 'the standard' as stated above. The figures of trained personnel at the surveyed dairy plants, the table below shows the percentage of trained people:

Dairy	Dairy 1	Dairy 2	Dairy 3	Dairy 4	Dairy 5	Dairy 6	Dairy 7	Dairy 8
Dairy trained personnel (Fully) (%)*	5%	12%	9%	2.50%	5%	3%	1.60%	4%
Dairy trained personnel short course**	38%	No data	45%	50%	48%	6%	1.60%	90%

Figure 50: overview of dairy trained employees in the dairy plants interviewed in Sweden.

* For example - trained on a formal course for at last 1 year, Falkenberg, Kold, Copenhagen levels.
**For example – trained on a 1, 2, 3, 4-day dairy related course.

Additionally, the recruitment agenda is difficult. The Swedish dairy industry faces a severe issue with an aging workforce and retention problems which then exasperate the ability to succession plan. This is the same issue for skilled engineers/maintenance personnel. The recruitment issue and business understanding are reflected at 100% across all sizes of dairy.

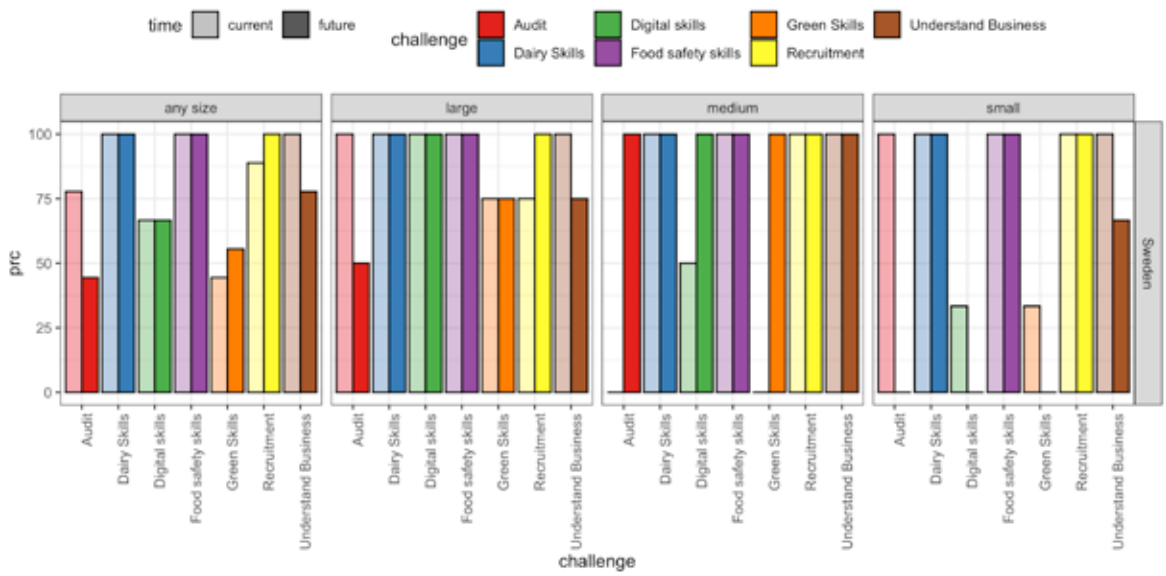

Figure 51. Comparison of dairy skill needs at present (light colored) and future (dark colored) based on the plant size (small < 50 production employees (PE), medium: between 50 and 150 PE and large: > 150 PE)

Closely following dairy skills was the need to integrate and understand digital skills/knowledge such as PLC, Automation, analytical skills. Finding people that are interested in working in the sector and with sufficient skill and caliber in enthusiasm and technical skills when competition is high from Saab, Volvo e.g. makes it even more difficult. However, for smaller craft and artisan dairies digital skills were of less importance as, surprisingly were green skills. A lot of dairies referred to green skills as 'common sense'. This was reflected across the EU in this smaller dairy cohort.

Audit and Green skills scored lower than the Dairy, Digital and recruitment needs and, in some cases, seemed like a burden from a cost point of view. So, the impact of actions especially on the green economy and quality, costs need a deeper understanding within the workforce. If resource efficiency via process improvement and green economy could be improved, then the industry will feel more easy with recruitment challenges but the ability to keep up with technology is seen as critical. In short, the following topics come to the fore:

1. *Too few people entering.*
2. *Too few skills.*
3. *Advancements in technology which are not fully understood.*
4. *Poor retention.*
5. *Lack of local or regional dairy training availability and dependency on Danish training.*
6. *The availability of trained staff from alternative industries.*
7. *Decisions difficult to take at line side by operators because they are not sure what is right.*

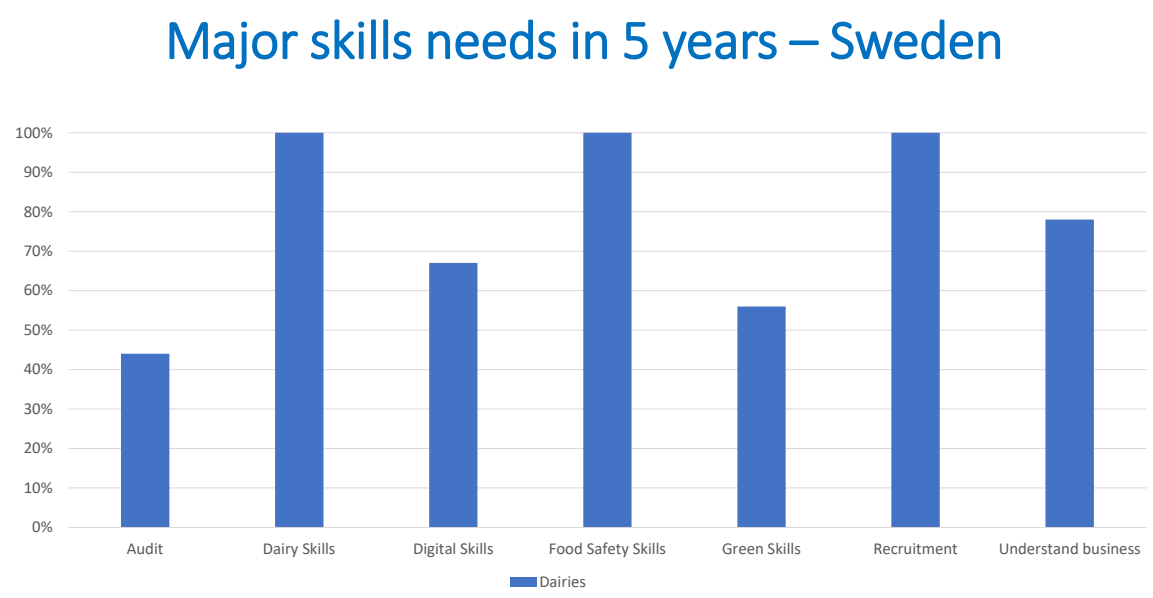

Figure 52. Major skill needs in 5 years in Sweden based on the 7 categories which scored most need overall.

There are some key similarities in Sweden as across other research countries and as expected key differences between small and artisan versus medium sized dairies which seem to align with larger ones on automation and PLC understanding within the digital skills agenda. Recruitment appears high in all areas and must remain a concern.

Critical topics include:

1. *Dairy Science – chemistry, microbiology, physics*
2. *Dairy Quality – impact of results data, decisions, quality improvements working with production teams, RCA, what is good quality, what is poor quality. Customer needs*
3. *Dairy unit plant operations – CIP, SIP, heat treatment, homogenization, separation, filtration – especially cleaning. Flow in the plant, factors affecting quality and efficiency.*
4. *Dairy Product understanding related to the site but to include a deeper understanding of raw milk quality (especially cheese, whey)*
5. *Recruitment and retention*
6. *Business understanding*
7. *Optimization/Processing Skills/Knowledge including packaging*
8. *Food safety including HACCP, hygiene, cleaning*
9. *Quality systems – HACCP, BRC, standards, auditing*
10. *Breaking the process equipment down so each part is understood and can lead to solutions at the line level*
11. *Breaking down the flow so RCA can be followed and understood at the line level*
12. *Problem solving, linking in all factors such as utilities as well as product issues*

Gaps

By other high-ranking topics

These topics are compared to the overall educational supply from the educational institutions, demonstrating clearly the gaps.

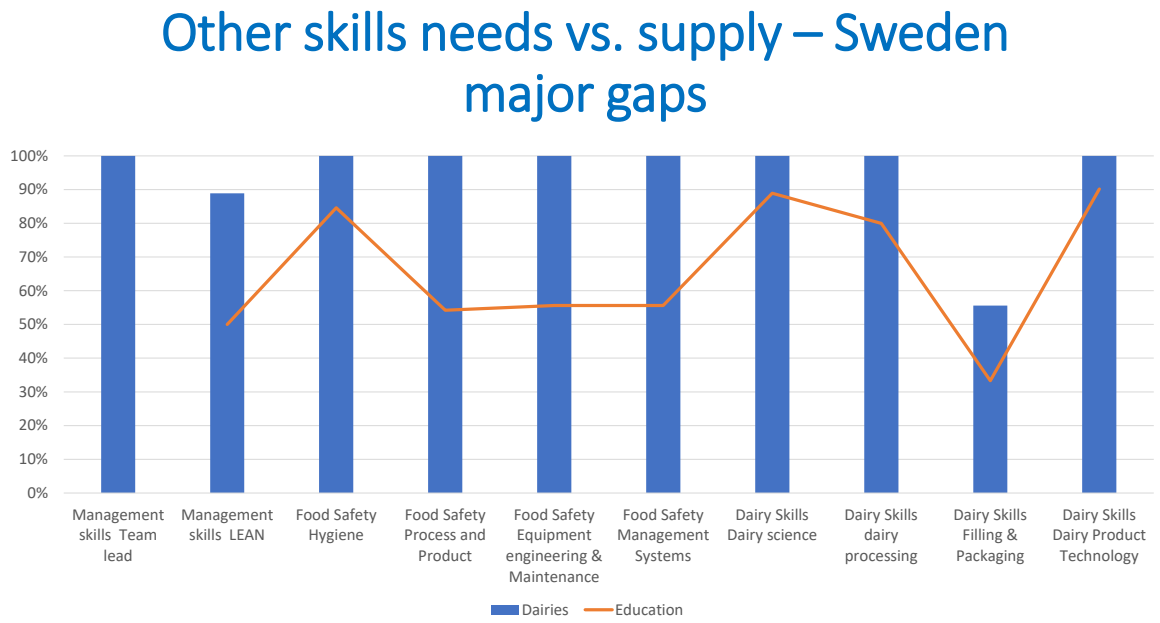

Figure 53. Other major skill needs vs. supply in Sweden. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Sweden (orange line).

The Swedish research at the dairies was compared with the dairy education in Denmark as explained above.

The Danish VET-provider, Kold College, graduates between 10 and 20 Swedish dairy technologists each year and in turn each year up to two Swedish dairy technologists go on to graduate from the Danish MSc in Food Science and Technology from Copenhagen University.

As across the EU, recruitment and retention are both major problems in Sweden for a number of reasons. First of all, it is very difficult to recruit young people to the dairy programmes as it suffers from an old-fashioned image, hard working with little reward, factory-based and not in an office and long hours. Secondly, as explained previously many young people go to Denmark to study dairy, as there is no full dairy education in Sweden. When these young dairy students finish their education, they opt to stay in Denmark (or elsewhere) if they receive an employment offer. A significant reason for young people to remain/travel abroad is because of a long-standing tradition in the Swedish labour market based on 'first in - last out', which, in simple terms, means that when a company must reduce their number of employees, the first ones to go, are the latest employed. It is not generally related to talent, skills or knowledge of the individual or even behaviours. With such uncertain employment conditions, these younger people tend to remain where they can see a viable future with a career.

This significant connection between Kold and Sweden is set as the 'standard' as in Denmark. A significant number of interviewees are graduates from Kold College. Site Directors are constantly 'pulled down to the factory shop floor' to make low-level decisions because teams do not know what to do all the time. It is not natural for operators, at lineside, to have dairy knowledge – unless from experience and what happened last week or what information they picked up from conversations, not

always based on fact/science. There is a huge need to link leaders with the right technical competences to make timely effective decisions. There is an assumption that the 'Dairyman' (Technologist), from Denmark training institutions, is a skill in itself. It is considered to be 'the base'.

Green Skills

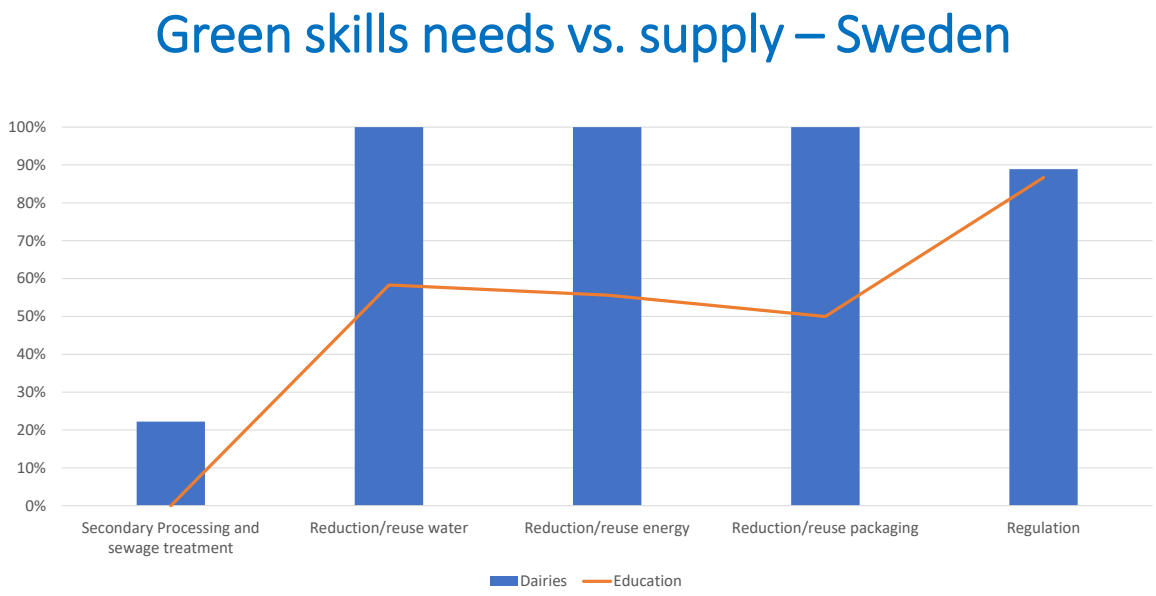

Figure 54. Green skill needs vs. supply in Sweden. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Sweden (orange line).

Small Swedish dairies found it difficult to articulate 'green' in a green economy as they linked the dairyman to having those green skills embedded in their way of working. The need is clear and the gap with education is strong as seen in the chart but when compared with dairy skills that are far more critical now and, in the future, than the Green Agenda, digital skills and audit. Small-size dairies need the essential skills, in their eyes, just to function properly in the future. *(see figure 51)*.
Contrasting with medium and large dairy plants where their need for Green Skills is higher *(see figure 51)* and maybe linked to product and emissions output into the local environment. So, any mistakes could lead to legal impacts.

Digital Skills

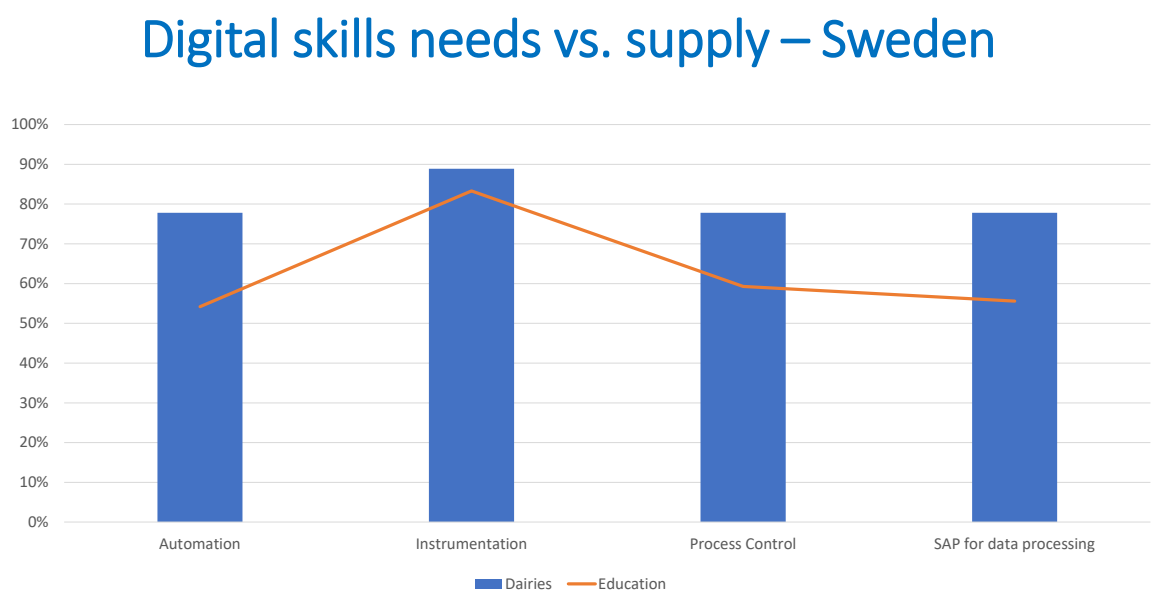

Figure 55 Digital skill needs vs. supply in Sweden. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Sweden (orange line).

The gap between supply and demand is less so than in other topic areas and one reason being interchangeability with alternate industries within Sweden such as Hi-tech communications, Volvo and Saab as examples. Digital skills fared better across the board and again notable differences with the smaller industrial needs.

Small-size dairies demand traditional skills, larger dairies need to grow and expand and they will see this through automation, robotics and more 'online' control. Interestingly this was confirmed by product type where digital came in 5th place but had a higher level of importance than green skills.

Norway

Historically, dairy education in Norway has been given at several levels. Industrialization of dairy processes and, later, the introduction of pasteurization brought the need for much greater competence in what developed into a large and diverse part of the food industry. Safety and product quality became more important than before. Dairy colleges were therefore set up to provide the necessary education for workers in the many industrial dairies that were established.

Dairy Colleges. Previously, there were about 20 Dairy colleges in Norway. They were established around the turn of the century (±1900) but by 1947, only five remained. None of these exist today as independent dairy colleges.

Ørland meieriskole (1894 – 2002). Dairy education was a 2-year study with the first year being practical experience at an allocated dairy. The second year had 24 student places and it was also possible for workers already working in the dairy industry to apply for the second, more academic year and thus improve their knowledge and understanding of dairy processes. A training dairy was built in 1994-5. However, in 1994, considerable changes were imposed upon the whole education system in Norway ("Reform-94"). The changes that affected Ørland meieriskole led to a drastic reduction in the numbers of students at the school, which was closed in 2002.

Some years after this, a study in Matteknikk (Industrial food production) was started at **Trondheim Fagskole**. This is a 2½year course and students attend the school for six periods each year and are otherwise in their jobs in the food industry. Where possible, the education is tailor-made to the individual student's place of work – that is to say that those with employment in the dairy industry

learn more about dairy processing than other students. The diversification of the food industry in general, and the dairy industry in particular, makes this generalization in food education certainly useful, but of course the focus on dairy is much less than it was previously, at Ørland meieriskole.

Jæren meieriskole, popularly known as "Bryne", was established in 1906. At a much later date, the only students who attended there were registered at NMBU (then NLH, see below) for a Masters in Dairy Science and Technology. All students received a whole year of practical experience before they began the remaining 4 yr of a 5-year Bachelor-Masters course at NLH. This all changed in 1999, when the Bologna Process of education was introduced in the whole of Europe, with a 3 yr Bachelor + 2 yr Master education as standard. Dairy education became less applied and more academic and the whole 5 years of the education now took place at NLH, Ås. The range of tailor-made courses offered in Dairy was also reduced.

Dairy education at Ås for over 120 years. Norges Landbrukshøgskole (NLH) was inaugurated in 1897 as an academic college and obtained full university status in 2005. NMBU is now organized in faculties, which are essentially a result of merging of former institutes within closely related disciplines. What was originally called the Dairy Institute, later the Department of Food Science, is now part of the Faculty of Chemistry, Biotechnology and Food Sciences (KBM).

The original master's education in Dairy science and technology provided the industry with highly qualified students who often quickly obtained a leading position in one of the (at that time) many dairies in Norway. The MSc in Dairy Science and technology was one of the original five major lines of study at NLH but was broadened in later years in answer to an increasing need for academic competence in other branches of the food industry. Changes in the dairy industry in Norway has also gradually changed. The dairies are fewer now but much larger and automation is increasingly introduced.

Dairy science and technology have retained its leading national status at NMBU, but resources have not been made sufficiently available to give other raw materials (vegetables, fruit, cereals, meat and fish) an equal footing. This unequal balance has existed for many years. The strong international standing of the education and research in dairy topics at NMBU has, however, been important in retaining this advantageous position. The faculty's various academic areas are organized in research groups. The centre for dairy academic activity in today's organization is the research group for "Dairy Technology and food quality".

As part of the educational activity of the group, courses in dairy science and technology are provided for both mainstream students, doctoral students and also as extramural courses for employees in the dairy industry. Students with specialization in dairy studies annually deliver a relatively high number of master theses focusing on dairy.

Education in Dairy Science and Technology at NMBU

The teaching of dairy academic topics has considerable depth and breadth. Regular academic courses of a pure dairy nature are: Milk and milk treatment (10 ECTS); Dairy Technology (15 ECTS); Dairy Technology practical training (5 ECTS), and Ingredients from milk (5 ECTS). The last three of these courses are given at Postgraduate (MSc).Extramural courses held are: Modern milk processing (10 ETCS) and Quality of milk (10 ECTS).

For this research only NMBU was interviewed as the only considerable dairy education in Norway. For longer periods/content in dairy education many young people with that extra interest in dairy go to Denmark to be educated either at Kold College, University College Lillebælt or Copenhagen University.

Demands from the Industry

In Norway five dairies were interviewed (TINE dairy being the major dairy company). Norway has 31 dairies in a country with five million people. Cheese production exhibits some minor growth but there is no need for any major expansion. Therefore, dairy education is considered as a part of a more general food industry education. As in other EU countries, the food industry is not held in high esteem by young people. It is therefore difficult to attract sufficient enrolment which would normally stimulate the Government to support the expansion of Food Science education. The industry has not led this, as in other countries. TINE SA is Norway's largest producer, distributor and exporter of dairy products with 11,400 members (owners) and 9,000 cooperative farms.

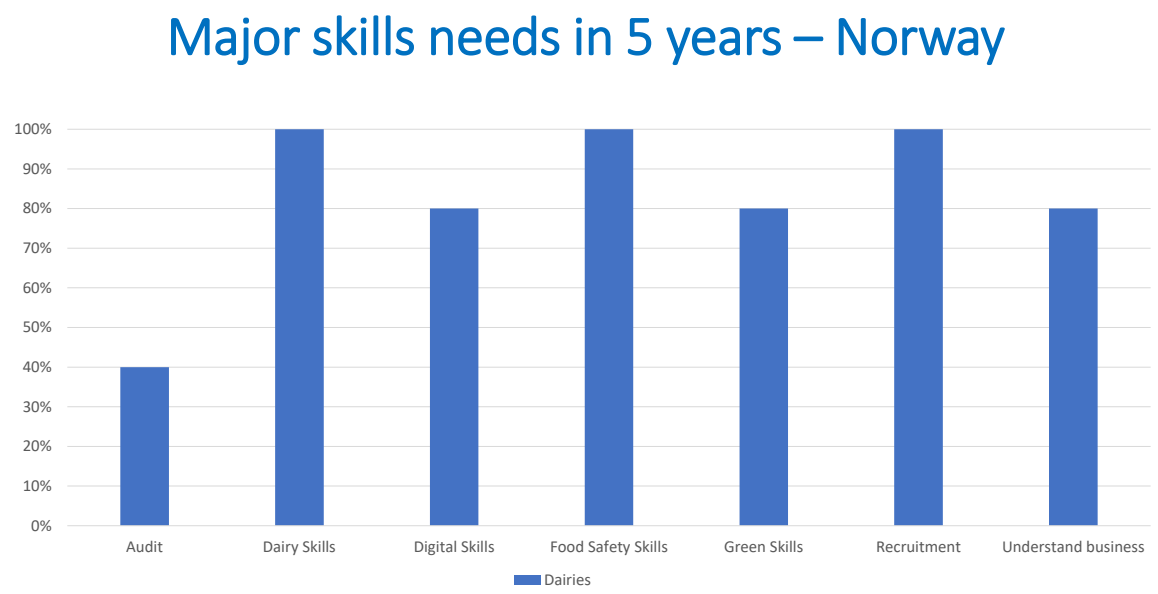

Figure 56. Major skill needs in 5 years in Norway based on the 7 categories which scored most need overall.

The interviews of five dairies in Norway indicated constantly recurring themes that are also reflected in surveyed dairies across the EU. The major issue remains the availability of trained Dairy Technologists where there is a distinct lack of dairy skills and knowledge as well as availability (Recruitment and Retention). All surveyed dairies indicated these as challenges. Both now and in the future, there is a distinct need for increased competence in:

- *Food safety including HACCP*
- *Dairy Science*
- *Digital skills – PLC, process control, fault finding*
- *Dairy processes (especially cheese)*
- *Processing Skills/Knowledge including packaging*
- *Quality*

The numbers of trained dairy personnel today present some serious aspects. There is an aging workforce with low skills for modern dairy processing. There is a considerable challenge to attract and retain workers across the whole food industry of which the dairy sector is significant.

The needs of Norwegian dairies are considerable. This bar chart indicates the future needs in all categories in all sizes of dairy. All categories are in high demand - between 75% and 100%. Of the seven categories only 'audit' seems to be quite well covered.


ECO
FRIENDLY
I LOVE NATURE

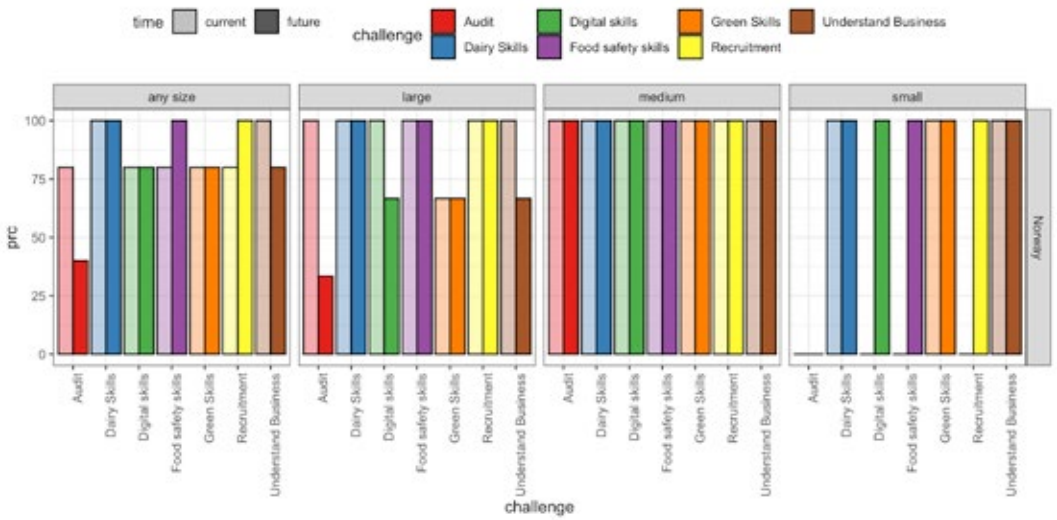

Figure 57. Comparison of dairy skill needs at present (light colored) and future (dark colored) based on the plant size (small < 50 production employees (PE), medium: between 50 and 150 PE and large: > 150 PE)

Gaps

When looking into more detail of the different demands. In the category of Management Skills, LEAN, team management and Corporate Social Responsibility are not covered by the dairy education, although LEAN courses are available at other faculties and hence taken by some Food Science students. Management skills are considered crucial by the industry (between 60% and 100% of dairies). However, as in other surveyed countries, the industry often views management skills as something to be developed at the site or as part of upskilling courses for selected employees. Food Safety is very well covered by the dairy education BUT 'Equipment Engineering and Maintenance'. On the other hand, core dairy skills as dairy processing, product technology, dairy science and dairy cleaning, seem to be quite well covered by the educational institutions, and the dairies also have a high need for these skills. The only two 'dairy skills', the education does not deliver on at all, or hardly, is 'material science' and 'filling and packaging', while the industry also has a high demand for these skills. As regards 'filling and packaging' the NMBU tried to start a Scandinavian Masters' education in Packaging Science but was unable to attract students at that time.

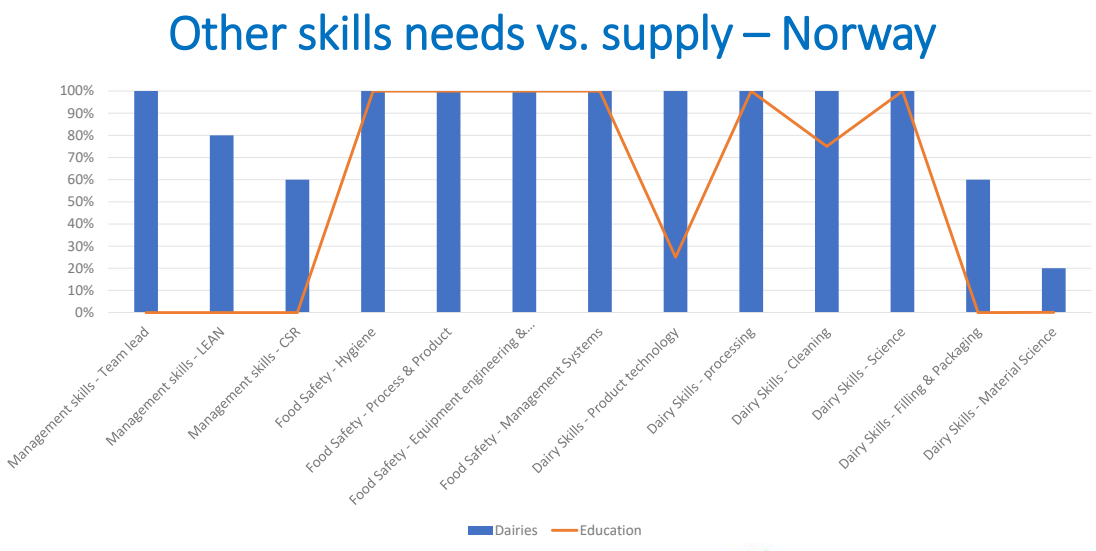

Figure 58. Other major skill needs vs. supply in Norway. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Norway (orange line).

Green Skills and Digital Skills

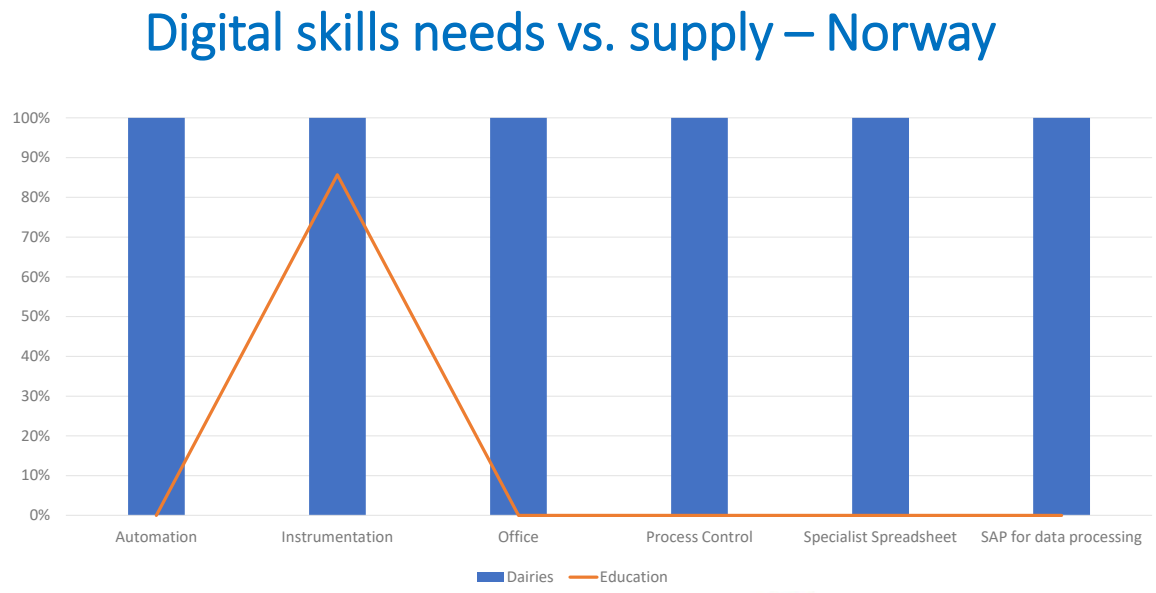

Figure 59 Digital skill needs vs. supply in Norway. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Norway (orange line).

As regards digital skills, the dairy education is lacking far behind. While the dairy industry has a high demand (all dairies) for 'automation', 'Office', 'process control', 'specialist spreadsheet', 'SAP for data processing', as well as 'instrumentation', the only topic the dairy education teaches is 'instrumentation', which is quite well covered with 87%. All other topics are not covered at all. One explanation on the lack of teaching in automation is the rapid technology development, that makes it impossible for educational institutions to keep up with the latest development, as they do not have the necessary equipment and steering units available. Furthermore, a major challenge is that dairy employees in charge of purchasing new equipment do not have the right skills and knowledge to select the best options and hence might purchase equipment that does not give the best product quality and stability.

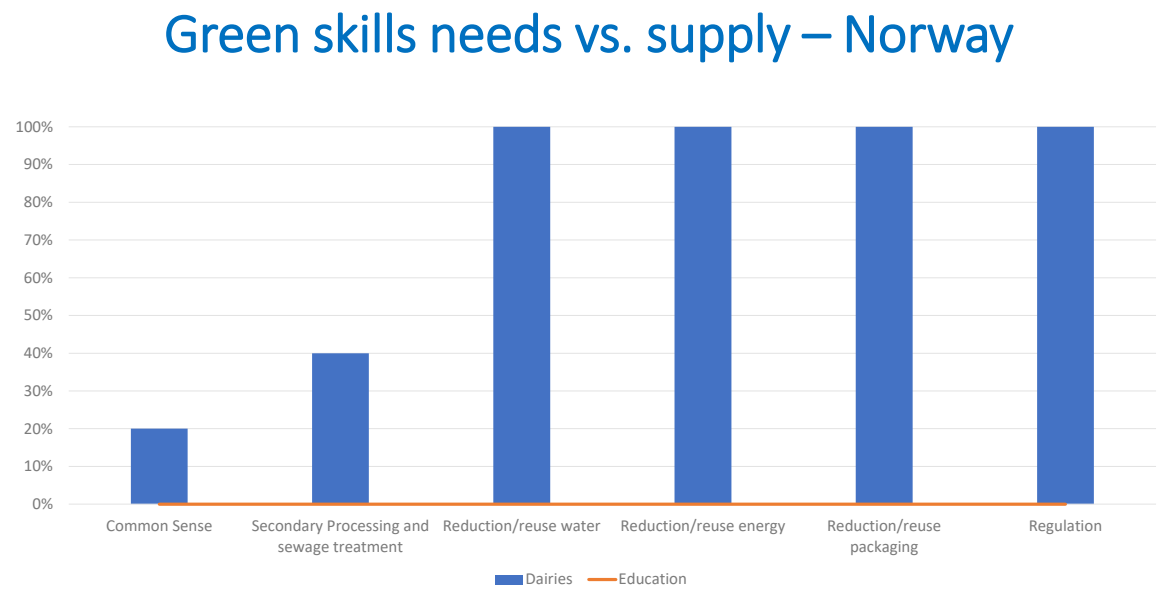

Figure 60. Green skill needs vs. supply in Norway. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Norway (orange line).

Regarding green skills, the dairy education does not teach any topics at all, whereas the industry points towards considerable need for this, especially in regard to energy sources and sustainability. All dairies indicated the importance of focus on ‘reduction and reuse of water’, ‘reduction and reuse of energy’, ‘reduction and reuse of packaging’, and not least regulation of the same.

Summary

The situation in Norway is similar to that in the EU generally and has the same challenges but appears worse since the remaining dairy education infrastructure is rather top-heavy. Dairy is a small food sector within a dominated fish, oil and forestry led wider economy. However, the Norwegian food industry is considered the largest mainland industry and within this, dairy is considered very important with TINE being the third largest company within the food sector in Norway. One major challenge noticed by the dairy sector is that dairy companies are steered by business people, who do not have a background in dairy science. This means that decisions are made mainly based on economical prognoses, which have led to a gradual reduction in the comprehension that knowledge and skills in dairy technology are imperative to the sector.

Finland

In Finland there are three ways to learn dairy skills. The key city is Hämeenlinna, which is home to Häme Vocational Institute which is the only educational institution in Finland where the students can obtain a vocational qualification in dairy production. The qualification also enables gradutes to work in other food sector companies.

Hands-on-work plays a big role in the education. During the three-year programme, the students spend roughly one year in on-the-job learning and training in dairy sector companies. Prior to this the students will have practiced their skills in the institute´s own dairy (pilot plant). In the pilot plant the students make such products as cheeses, butter, ice cream and yoghurt. The institute has also own laboratory. In the microbiology and chemistry lab the students take various samples of the ingredients and the finished products and interpret the results.

Hämeenlinna is also home to Häme University of Applied Sciences (HAMK). At this university the School of Bioeconomy functions in the fields of natural resources and rural development. The school also works together with Häme Vocational Institute, which provides secondary vocational education and training. Normally, around 40 students start studying Biotechnology and Food Engineering. Of these approximately 2 to 15 (depending on the year), have qualified themselves previously working in the dairy sector.

The University of Helsinki has The Faculty of Biological and Environmental Sciences which is Finland’s most high-profile and extensive hub of research and teaching in the field. At this university it is also possible to study food production and milk technology.

Demands from the Industry

Three Finnish dairies were interviewed, however there are only two answers recorded due to Valio Jyvaskyla and Valio Joensuu answering together. Because of this, Finnish answers can sometimes look on-off (0 % or 100 %) when the truth is somewhere in between.

By selected topic

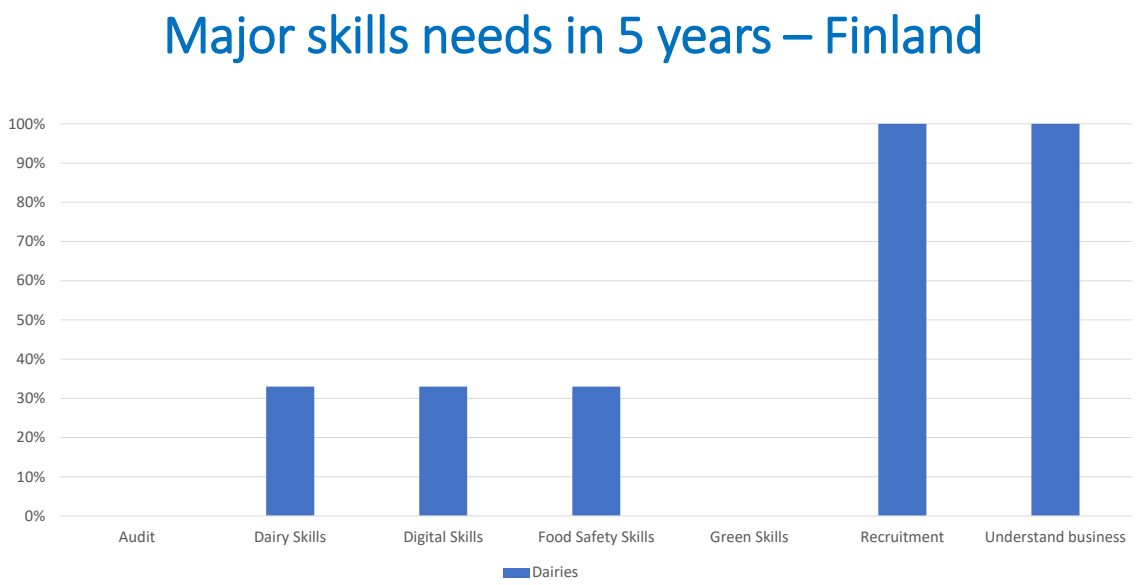

Figure 61. Major skill needs in 5 years in Finland based on the 7 categories which scored most need overall.

The last couple of years, students have shown less interest in studying food or dairy business than in previous years. On top of that, in the next 5-10 years there will also be a significant number of retirements. Against this background, it is understandable that recruitment is of big concern (100 %) to the dairies. Especially, for those dairies that are situated in the countryside far away from large cities.

Understanding business was also a need expressed by 100 % of the interviewed dairies, whereas dairy skills, digital skills and food safety skills were of concern to only a third part of the interviewed dairies.

Audit and green skills were not mentioned but most likely the reason for this is that there were so few answers. For example, green skills have been a very popular topic in Finland in the last few years. Finnish dairies are also trying to greatly reduce their greenhouse gas emissions.

Gaps

By other high-ranking topics

These topics are compared to the overall educational supply from the educational institutions, demonstrating clearly the gaps.

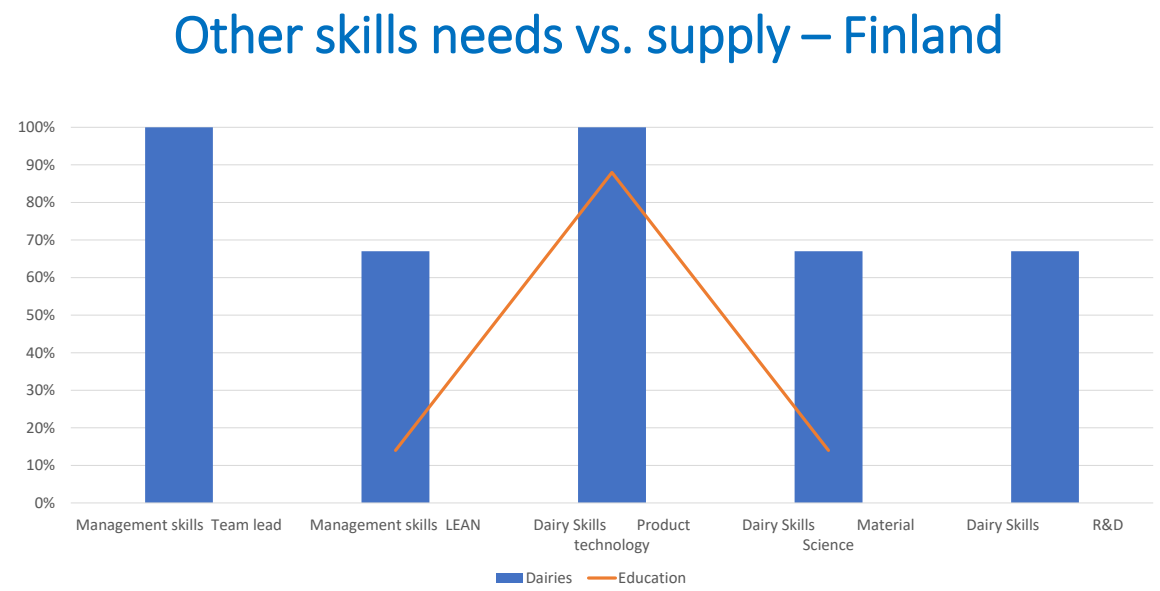

Figure 62. Other major skill needs vs. supply in Finland. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Finland (orange line).

Asked into sub-categories, some of the skills that appeared to be in very high demand are team-leading skills, as a sub-category to 'management skills', and product technology as a sub-category to dairy skills'. Both with a 100 % rating. Also, LEAN skills were rated as highly important by the dairies, as was 'material science' and 'research & development' as sub-categories to dairy science, all with 66 %. All of these categories, but 'product technology', are hardly taught at the educational institutions, hence showing serious gaps. However, studying at Häme University of Applied Sciences (HAMK) being a team leader and developing those skills are also required for the course.

Green Skills

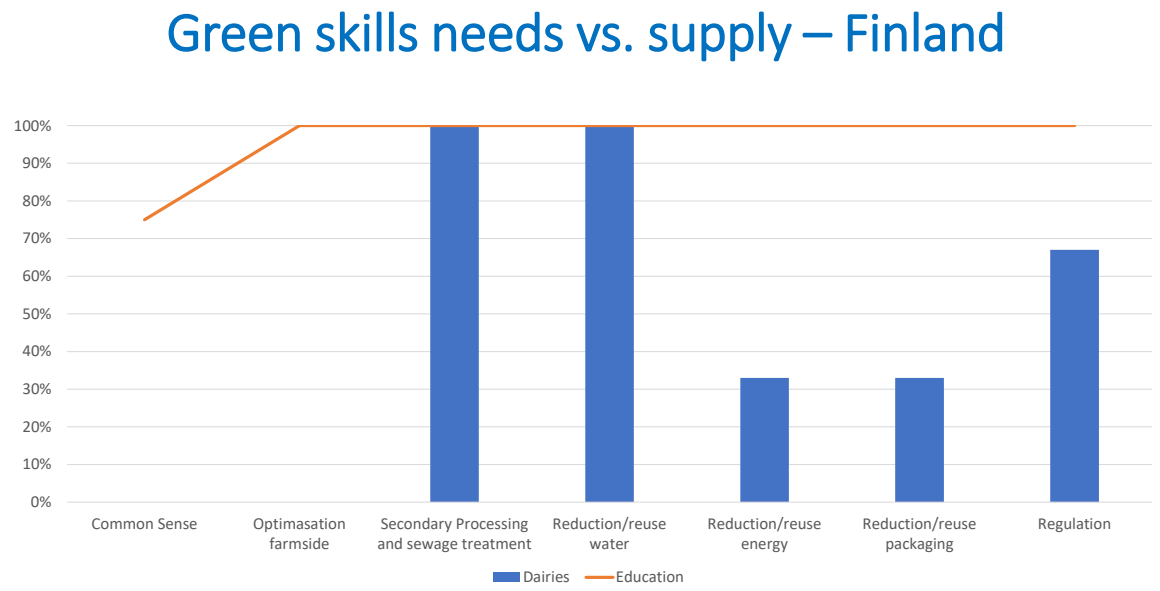

Figure 63. Green skill needs vs. supply in Finland. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Finland (orange line).

Finnish dairies find green skills to be very important. Dairies answer that sustainability and having an environmental conscience are key elements and they have invested and are going to continue to invest in environmentally friendly solutions now and in the future (knowledge of waste reduction, biogas, energy, water and recycling). Finnish consumers are more aware of the environment and will base their decisions on how the products impact on the environment. Also, on education these themes have taken on a larger role over time. Students also think this subject is important and interesting. Dairies are hoping for greater education concerning non-milk-based products.

Digital Skills

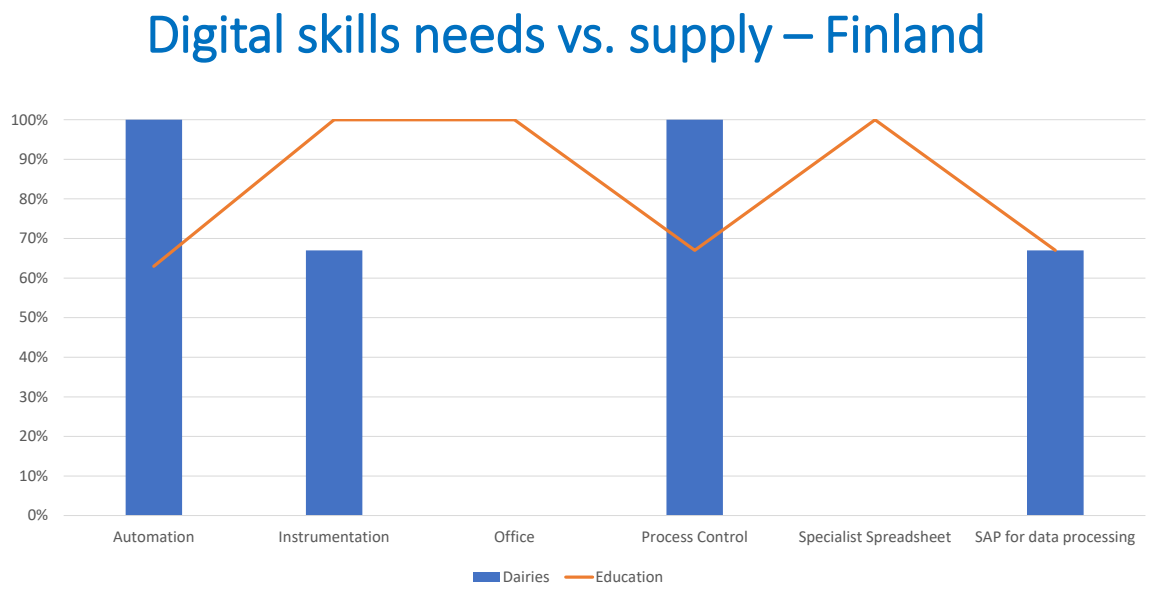

Figure 64. Digital skill needs vs. supply in Finland. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Finland (orange line).

Digital skills are seen as being highly important now and also in the future. Automation and Process Control are rated as highly important to all dairies, whereas the educational institutions only cover around half of the topics connected to these two areas. The dairies seem to be quite well covered on skills related to the Office-package and specialist spreadsheet. In relation to instrumentation and SAP for data processing the demand from the diary plants are well covered by the schools.

Poland

The research conducted in Poland, covered four Polish dairies of different sizes (1 large and 3 small scale dairies). Among these dairies, four produce butter, two produce cheese, four produce fermented milk products and drinking milk, and milk powder and dairy ingredients is produced in one dairy.

Furthermore, one educational institution (a dairy science and technology department) was interviewed.

Demands from the Industry

With an overwhelmingly rating of 100 %, recruitment and business understanding were found as the major skill needs in 5-years' time in Poland. These are followed by digital skills, dairy skills and food safety skills, all rated with 33 %. Green skills and audit were rated with 0 % need by the dairy plants in Poland. Green skills, however, are treated separately further down.

One of the major challenges in Poland in regard to attract enough young people to the dairy education lies with the fact that the educational institution is placed very far away from where the dairy plants are placed. Efforts are currently working on bringing the education to where the actual industry is placed.

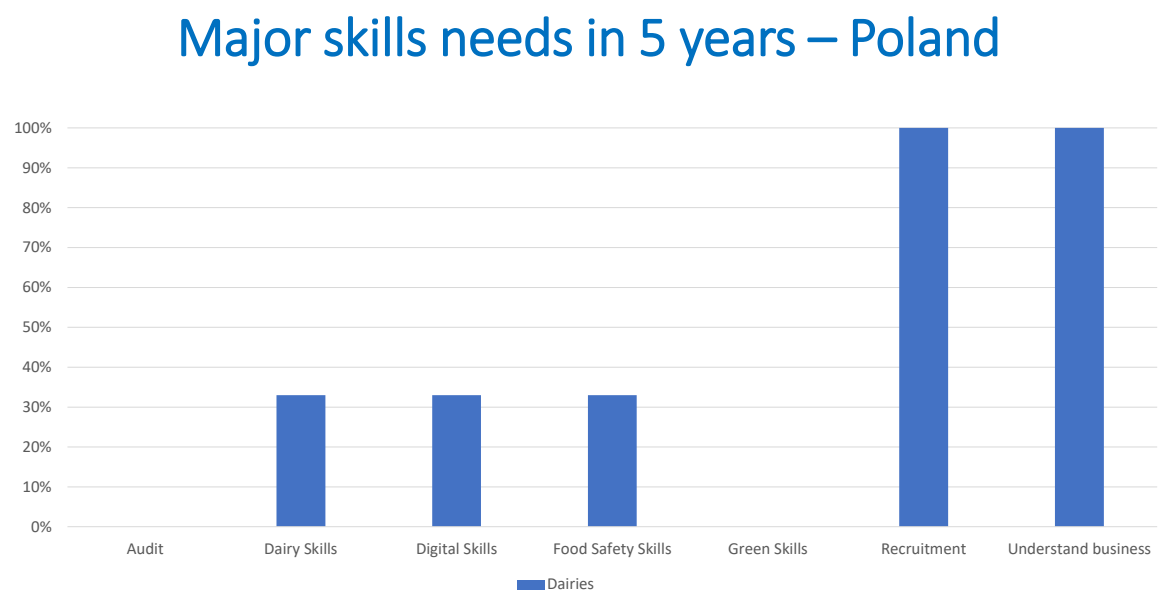

Figure 65. Major skill needs in 5 years in Poland based on the 7 categories which scored most need overall.

When considering plant size, the need for food safety was rated with 50 % by the small-scale dairies. The biggest need stated by the small-size dairy plants were dairy skills and understand business. Whereas, for the large dairy plant recruitment was stated as the biggest challenge.

Gaps

By other high-ranking topics

These topics are compared to the overall educational supply from the educational institutions, demonstrating clearly the gaps.

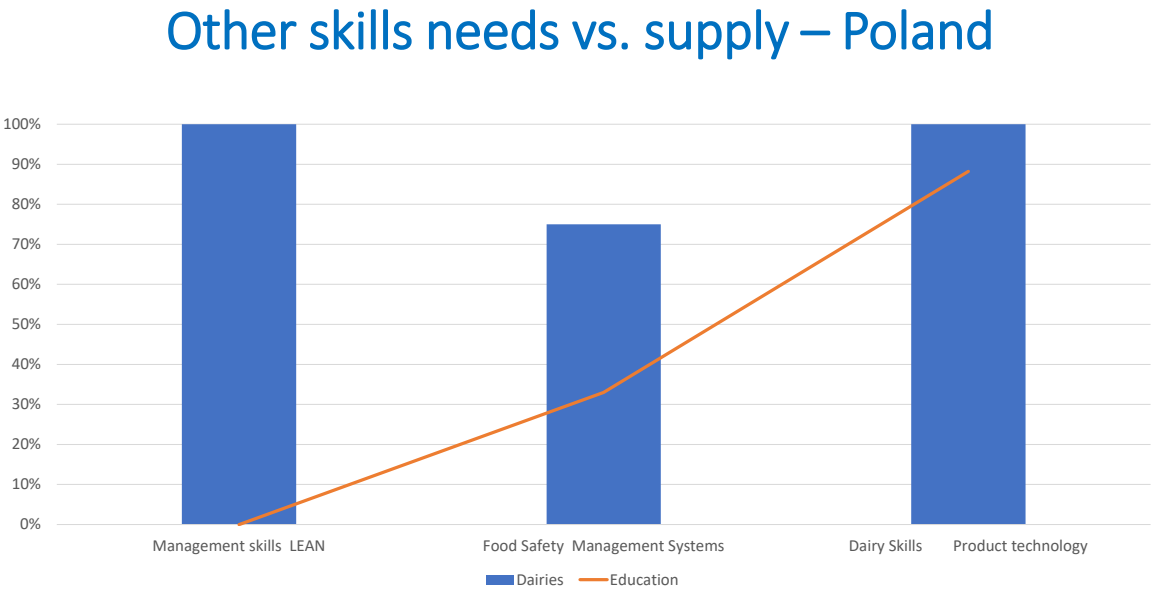

Figure 66. Other major skill needs vs. supply in Poland. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Poland (orange line).

When divided into sub-categories, three categories of major concern to the dairy plants appear. These are LEAN behaviours as a sub-category to 'management skills', 'management systems' as a sub-category to 'Food safety', and as a sub-category of dairy skills, 'product technology'. LEAN and product technology were both rated with 100 %, whereas 'management systems' was rated with 75 %. The gaps are greatest in relation to LEAN-skills which is not taught at all at the educational institutions, so the gap is 100 %. In relation to teaching in management systems, the gap to reach the level requested by the industry, is of 45 %.

Green Skills

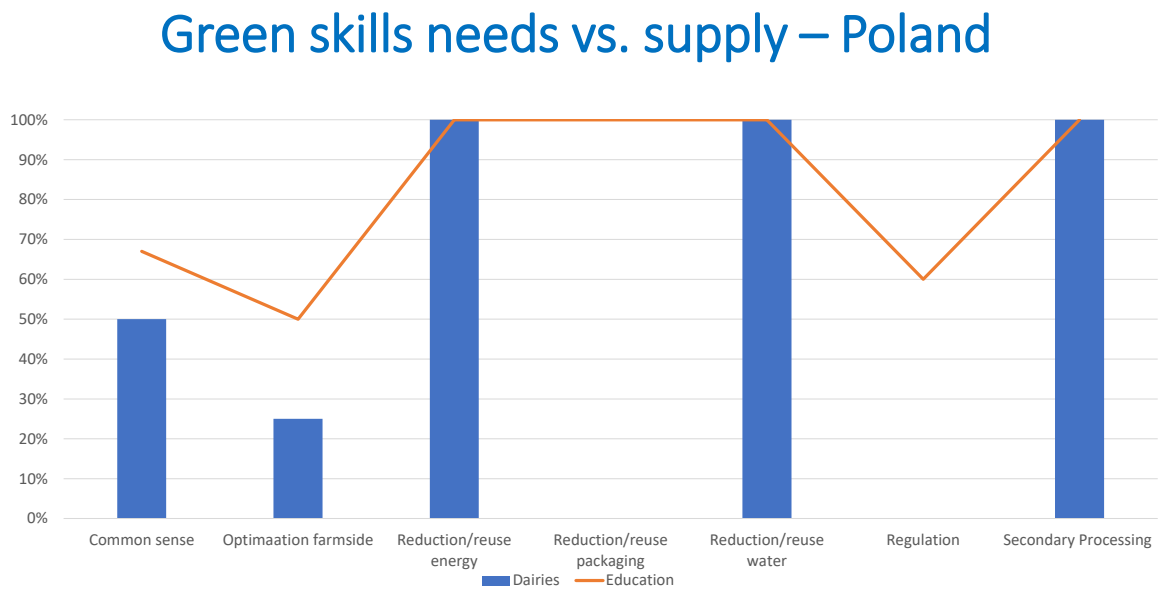

Figure 67. Green skill needs vs. supply in Poland. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Poland (orange line).

When asked specifically to challenges and needs within the green skills agenda, the dairy plants rated three of the sub-categories as highly relevant or in need of skills. These are the reduction and reuse of energy and water, as well as secondary processing (sewage treatment), all three rated at 100 %. In all three areas, the educational institutions claimed to cover the subjects at same level as requested by the industry, hence not creating any gaps. Overall, the dairies claimed that dealing with the green agenda, is 'common sense', which means that they would expect green awareness from their employees.

In all subjects related to green skills, the dairy education in Poland seems to be performing satisfactorily.

Digital Skills

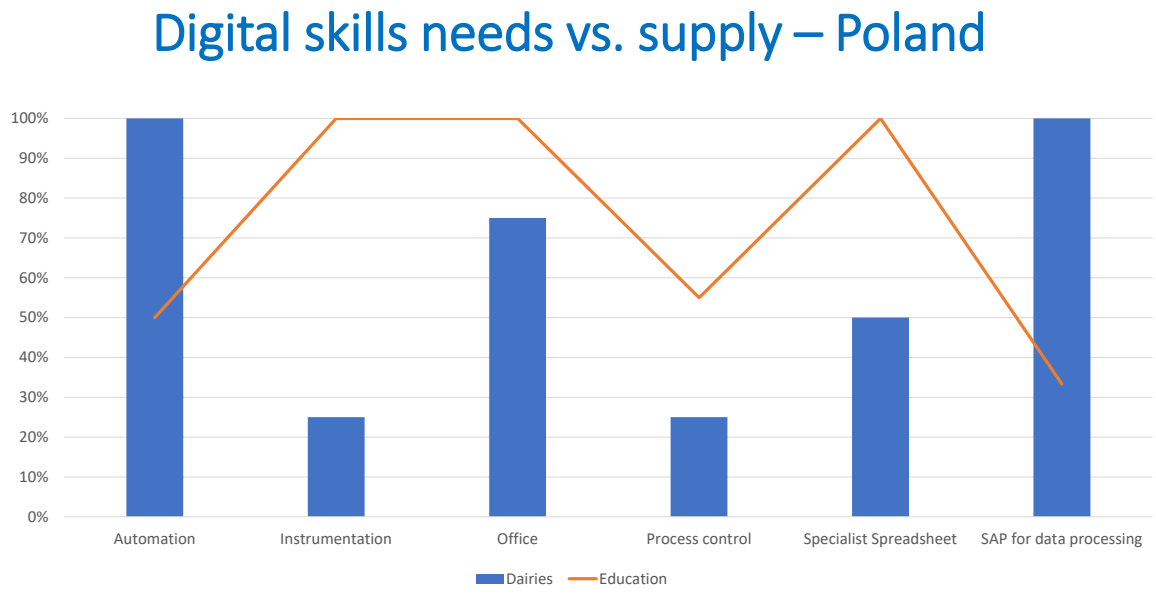

Figure 68. Digital skill needs vs. supply in Poland. The blue shows the percentage of importance to the dairy plants compared to the actual supply in these specific topics by the dairy schools in Poland (orange line).

Digital skills were not rated very high as an overall concern by the dairy plants, but when they had to answer specifically to different areas of digital skills, they rated 'automation' and 'SAP for data processing' with 100 %. Subjects related to automation are only covered by the educational institutions with 50 %, which create a gap of 50 %. In regard to SAP for data processing, the educational institutions only teach a third part of the subjects related to this area, creating a gap of 67 %.

Also, Office and specialist spreadsheet were identified as considerable need by the dairy plants (75 and 50 %). Both these areas are very well covered by the educational institutions.

Gaps

When the largest gaps of Poland are compared at current, the highest gap is ranked as dairy skills as 100% and 88.2% by the industry and educational institutions, respectively. These are followed by digital skills, food safety skills and audit, respectively at current. In the future, the highest gaps are expected on digital skills (85.7 %) and dairy skills (88.2 %) by the educational institutions, while the dairy skills (75 %) and digital skills (50 %) are expected by the Polish dairy industry as the most significant gaps.

When the largest gaps mentioned by Polish educational institutions and Polish industry are compared; management skills including lean behaviors, green skills including secondary processing and sewage treatment, digital skills including system applications, product for data processing and digital skills including automation and dairy skills including dairy product technology are found as major gaps (100 %) by Polish industry, while the largest gaps are ranked as dairy skills including dairy product technology (88.2 %), digital skills including automation (50 %), food safety skills including management systems (33.3 %) and digital skills including systems applications and product for data processing (33.3 %) by Polish education institutions. The main reason for the indicated gaps is the fact that people who do not have special education in dairy science often work in dairy companies.