Chapter 6
Air Compressors or Compressed Air: Harvesting the Benefits

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Abstract The customers of air compressor manufacturers are traditionally industries that procure and use these devices for the production of compressed air, which is needed in their production processes. Because the application of air compressors for the production of compressed air is quite often not regarded as a core competence by these customer industries, the efficiency in the air compressors can usually be significantly improved. New business concepts have been designed that target the more efficient use of air compressors. In this chapter, these new compressed air contracting schemes will be analysed based on 6 case studies in German industry.

6.1 Introduction

Air compressors are mechanical engineering products that enable their buyers to produce compressed air for their production processes. The technical configurations of air compressors distinguish between turbo compressors, oscillating positive displacement compressors and rotating positive displacement compressors.

The manufacturers of air compressors in the EU achieved sales of 7 billion euro in 2012. Aside from Germany (approx. 3 billion euro), the most important European producers are Italy (approx. 1.4 billion euro), Great Britain (approx. 0.2 billion euro) and France (approx. 0.1 billion euro) (PRODCOM 2013). The production of compressors in the EU is largely export-oriented. Exports comprise approximately two thirds of overall production. The most important export markets are the EU countries, China and the USA. In recent years, the production of compressors has been characterised by stagnating production and falling employment.

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Applying air compressors to efficiently generate compressed air presumes their proper and demand-oriented dimensioning, including the correct splitting of compressor sizes, the application of variable speed drive compressors and the selection of compressor types. In addition, a control system is needed to select the set of compressors that most efficiently matches the respective demand.

The life cycle costs of air compressors are not dominated by the investment but by the operating costs, primarily for the electricity supply. Energy costs typically account for four-fifths of the total life cycle cost. The energy consumption of compressed air systems can not simply be determined by the efficiency of the compressors, but primarily by the interaction and efficiency of all the components in the compressed air system (Radgen and Ruppelt 2003). Analyses have determined that the economic efficiency of compressed air production is often suboptimal when industrial customers are purchasing and operating the compressors (Radgen and Blaustein 2001). Because the customer industries do not regard the production of compressed air as their core competence, only minor efforts are often made to optimise the compressed air production. Instead, the key focus of the customers is the availability of the system. This emphasis leads to a situation in which roughly one third of the 14 TWh of electricity used each year to generate compressed air in Germany (80 TWh in the EU-15) could be saved by optimising air compressor applications (Radgen and Blaustein 2001).

This significant energy saving potential has induced the design of new business models for the manufacture and use of air compressors, which have been realised and tested over recent years. In these new service-oriented business models, industrial clients requiring compressed air no longer invest to buy and operate compressors. In this new business models of compressed air contracting, compressors are owned and operated by the compressor manufacturers or any other third party offering a similar service. The industrial customers typically pay for each cubic metre of compressed air supplied.

Electric power companies are becoming increasingly involved in these business models because the majority of the costs in these types of operating schemes are not attributed to the capital expenditure for the compressors or other components of the compressed air system, but to operational expenditures primarily for the electrical consumption of the compressors and driers. The following groups of actors are active in the German market, offering new business models to supply compressed air to industrial customers:

- Manufacturers of air compressors (e.g., Alup, Atlas Copco, Boge, Compair, Kaeser, Ingersoll Rand)
- National or supra-regional electric power companies (e.g., E.ON, RWE, EnBW, Vattenvall)
- Regional and municipal energy companies (e.g., GEW Rhein-Energie, Mark-E, MVV, Stadtwerke Detmold, Stadtwerke Düsseldorf, Stawag, Wuppertaler Stadtwerke)
- Service providers with or without a special focus on compressed air technology (e.g., Dalkia, Elyo, Getec, industrial estate operators, UltraAir, Systemplan)

- Technical building services/technology providers (e.g., GA-TEC, Hochtief Facility Management, IMTECH, NGT)
- Regional energy agencies, planners and compressor retailers (e.g., Energieagentur Mittelfranken, Drucklufttechnik Kruckenberg, Uhl Drucklufttechnik).

Different technology options, different actors on the market and a significant energy and cost saving potential are leading to different business models, as the individual interests of the companies can be quite different. To understand the new business models offered for generating compressed air, new empirical evidence is necessary.

6.2 Methodology and Database

To obtain the necessary background and understanding, we were able to convince six companies to discuss and analyse their compressed air business models. In-depth, face-to-face interviews were conducted with most of these firms; others only participated in telephone interviews. All of the six companies were particularly concerned about confidentiality, and so the presentation of data and findings is anonymous to ensure that they cannot be traced back to the source. Table 6.1 presents an overview of the companies in our sample.

The data for the six case studies presented in Table 6.1 clearly indicate the variety of actors, business perspectives and roles. Hence, the case studies present well balanced information relative to the different perspectives of the different stakeholder groups for the new business models. The companies examined included compressor manufacturers, electric power supply companies and a compressed air service provider.

The interviews proved that until now, new business models in compressed air tended to be implemented for larger firms by larger firms. The number of employees in the table refers, however, to the respective firm/company as a whole and not just to the group responsible for the new business model. As a result, the statements made for the group also apply to the companies offering operating schemes via subsidiaries (typically the large electric power utilities). If the operating schemes for compressed air supply are outsourced as separate companies for each costumer, these activities are usually bundled together with operating schemes in other areas such as, e.g., heat supply, cold supply, combined heat and power (CHP) or other services.

All the firms represented in the case studies had already implemented several projects that applied the new business models at the time of the analysis; the numbers ranged from 5 up to 80 projects. The majority of the projects were realised by the compressor manufacturers.

Table 6.1 Overview of the case study examples in the analysis of new business models conducted for compressors/compressed air supply

No.	No. of employees	Sector	Start of new business model activities	State of new business model activities	Clients for the new business model	Number of new business model contracts
1	>1,000	Manufacturer	1991	Continuous expansion of activities	Automobile suppliers, chemical industry	Approx. 80
2	>1,000	Manufacturer	1989	No active marketing; offer only on customers' demand	Automobile suppliers, chemical industry	Approx. 50
3	<1,000	Manufacturer	1995	Discontinued activities	No information	Approx. 5
4	>1,000	Service company	2000	After intensive start-up phase, with-drawal. Currently renewing activities linked with comprehensive energy saving contracts	Automobile suppliers, chemical industry, glass industry	Approx. 10
5	>1,000	Service company	No data	Continuous expansion of these activities	Mechanical engineering, chemical industry	Approx. 10
6	<100	Compressed air contractor	2001	Significant increase in turnover since 2006, continued expansion	Glass industry, chemical industry, automobile, energy	Approx. 10

6.3 Characteristics of the New Business Models in the Analysed Sample

In all cases of our sample, the stakeholders in compressed air contracting offered to assume complete responsibility for the generation of compressed air. The contractor (compressor producer, utility or service provider) plans and installs a compressor station on the premises of the contracting company (industrial customer with compressed air demand). This compressor station is either installed in a room provided by the contracting company or in a container owned by the contractor and placed on the contracting company's premises.

In most of the cases, the electricity to generate the compressed air is supplied via a separate sub-meter by the contracting company. The actual electricity costs are settled between the two partners or, if the power is provided free of charge by the contracting company, a maximum electricity consumption for the production of compressed air is fixed. Otherwise, the contractor would have no interest in installing and maintaining an energy-efficient system. If the contractors need to purchase the electricity directly from an energy supplier, it typically negatively impacts the compressed air price. The contractor would have a much lower electricity demand, and hence would obtain less favourable rates and terms for the electricity purchase than the contracting companies, which have a much higher total demand.

All the operating schemes realised in the new business models typically end at the pipe flange of the compressor station, at which point the air meter is installed and after which the client's air distribution system starts. An air meter reading is used to determine the payments from the client to the service provider based on contracted terms and conditions. Aside from the volume of compressed air delivered, sometimes the quality of the compressed air (pressure, humidity, oil content, dust, etc.) is measured and recorded to ensure that the agreed-upon compressed air quality standards are respected, as higher quality (especially higher pressure) goes together with higher energy consumption. The pricing schemes for compressed air delivery are typically established along the same lines as other energy carriers such as electricity and gas. Remuneration schemes typically comprises of a fixed monthly price, which is usually calculated in such a way that the investment's depreciation is covered, and an additional consumption-dependent price per cubic metre of compressed air.

As operating costs are the dominant cost factor, the primary basis for calculating the service cost is the volume of compressed air, which must therefore be determined as accurately as possible. The compressed air stations owned and operated by the customers do not typically measure the amount of compressed air produced, but for the new business models, these numbers are essential. Because precise flow metres, which needs to be temperature and pressure compensated, are relatively expensive, for small compressed air systems, it is usually more appropriate to determine the volume of compressed air delivered in a simpler way. Instead of the volume of compressed air, the numbers of load hours of the air

compressors are determined and multiplied with the nominal compressed air production of the compressors based on their technical data sheets to obtain the volume of compressed air delivered. Sometimes the contract also fixes a price directly related to the number of operating hours, omitting the calculation for the amount of compressed air produced.

In comparison, energy savings contracting and billing based on raw material purchases or goods production are not widely established (Fritz 2002). In energy savings contracting, the customer gets typically promised cost savings based on his current costs for compressed air. In this business model, the contractor therefore needs to realise cost savings by reducing the energy consumption for the compressed air production to finance the investment and to deliver cost savings to his customer. This type of energy savings contracting can only be successful if a significant energy savings potential exists. Although this magnitude of savings can be typically ensured for compressed air (average saving potential >30 %), it is difficult to distinguish between the savings linked to technical improvements and the impact from a change in compressed air demand on consumption, the primary reason that energy savings contracting is not favoured despite the large saving potential.

Business models that are linked to the clients raw material use or goods production output would be attractive for the customer, as he would have clarity on the share of the compressed air cost in his products. However, this model would involve a high risk for the contractor as production is often uncertain and companies are unwilling to share their market expectations for the products produced. The required risk premium will, in most cases, therefore make this type of offers unattractive for customers.

The structure of the new business models in the analysed cases can be generalised and shown in a structured way using the following criteria: ownership of the system, division of labour into operation and service, location of the system and exclusiveness of use. By these criteria, several concepts can be distinguished:

In the first business model structure (case studies 1, 2 and 3), the installation is financed by either the compressor manufacturer or a leasing bank. For smaller systems, financing is typically provided by the manufacturer as part of his normal credit line with his banks. For larger compressed air stations requiring a significant investment, in most cases, a leasing bank acquires ownership of the compressors. Usually, the suppliers work together with the same leasing bank because the bank needs to understand the business model and the risks. The compressor manufacturer operate according to the sale-and-leaseback method.

Conventional financing for the new business models via existing credit lines from the banks is straightforward for the service providers because the business volume of the operating scheme is still less than 5 % of the turnover for the compressor manufacturers.

The billing for the business model is based on compressed air consumption; contractually, the minimum and maximum purchase quantities are always defined. A minimum and maximum is regarded as necessary to enable the correct and efficient planning and dimensioning of the compressed air system. The compressor

manufacturer also provides the required staff to operate the system; they are typically not required to be on site at all times. The service and maintenance of the compressed air system is also provided by the compressor manufacturer, which is also the case in the traditional business model. The choice of who provides the operational personnel is typically not decisive for compressed air supply because the systems can be operated and controlled remotely without personnel present on site. The remote monitoring and control of compressed air systems via telephone or LAN/internet connection has become widely established. A system equipped with this type of technology can be monitored and controlled from anywhere in the world. At the same time, error reports are automatically sent to the next service technician. If compressor failures do occur, these can be addressed promptly by the dense network of service technicians from the compressor manufacturers. In addition, installations are typically composed of more than one compressor and are planned based on the $n - 1$ rule. This rule means that even if the largest compressor fails, the remaining compressor units would still be able to satisfy the maximum compressed air demand.

A second business concept, which differs from the first, was found in cases 4 and 5. In this concept, the electric power companies sponsor and promote the business model. These companies invest in compressors and equipment and offer compressed air supply to industrial clients. Although the electric power companies are better equipped financially compared to the interviewed compressor manufacturers (a compressor is much cheaper than a power plant), the supra-regional energy service company still always involves a leasing bank for the financing to keep the assets off from their balance sheets. The interviewed regional utility, in contrast, prefers internal financing and keeps the compressed air systems operated for their clients on their own accounts.

The electric power companies provide the staff to operate and service the systems. However, there are some maintenance jobs (e.g., remounting the compressor block or changing the compressor stage) that must be performed by specialised staff from the compressor manufacturer. As a result, the energy service companies place themselves in a situation of partial dependency on the compressor manufacturer because they must rely on the prompt delivery of spare parts or prompt repairs in the case of a compressor failure. At the same time, the energy service companies are the biggest rivals of the compressor manufacturers in the competition to sell compressed air to a customer. As long as the significance of the new business models in the overall market for air compressors is still low, the manufacturers will attempt to participate in such business together with the energy service companies through cooperation as an option to increase their product sales.

For the supra-regional utilities, supplying several customers at once, such as in an industrial park, or supplying a single costumer with a broad variety of energy services (cooling, heating, lighting, electricity, etc.) is of interest and potentially within the scope of the new business models. However, the utilities have not yet realised these types of projects.

An important aspect of the new business models for compressed air is that each single contracting customer requires an individual design and layout for the

compressed air supply system, even if reference can be made to a construction kit of standard components (compressors, driers, control units, condensate treatment, filters etc.). So compressed air is not comparable to the commodity business of selling electricity and gas. For this reason, the supra-regional energy supply companies are willing to cooperate with an external service provider that is responsible for the detailed engineering and for analysing the current condition of the system in place. In contrast, the regional utility also analyses (including measurements onsite) and plans the system using its own internal staff.

Unlike the business models described so far for supplying compressed air, in case 6, a specialised service provider offers the business model. A leasing bank acquires ownership of the compressors and transfers ownership to the service provider as the compressed air supplier and operator. The service company provides the required staffing for the plant. The staff works together with the compressor manufacturer to provide maintenance services.

Comparing the different business models presented above, it is clear that the key difference is not in the concept but the type of company providing and offering the business model.

6.4 Experiences and Lessons Learnt

Although the compressor manufacturers first experiences operating their compressors to supply compressed air at their customers plants usually date back many years, their interest in these business models was and still is limited. The acquisition cost for this type of business models and the added risk from the long-term contracts is often seen as too high compared to the achievable profits because of the greater complexity of providing a service rather than simply selling a compressor. The compressor manufacturers have only recently become partially active again in this business, due to the growing competition from the energy supply companies, energy service companies and specialised service providers.

For the energy supply companies, compressed air contracting is primarily interesting within the framework of building long-term customer ties (electricity contracts) and as a way to further develop business relationships by assuming responsibility for other supply systems such as, e.g., heat or cold. Problems arise for the energy supply companies when entering the market because they have no experience with compressed air supply and decentralised systems; however, they are considering a market entry seriously since the German “Energiewende”. This lack of experience and the associated reluctance on the part of industrial customers to commission the energy supply company with their compressed air supply often resulted in low cost offers during the market entry phase with the aim of winning clients to build a project reference list. Because the turnover share of contracting is very low during this initial phase, these companies could afford to make low or zero margin offers and even risk losses with some projects if the assumed boundary conditions would change. However, covering costs and lucrative

compressed air contracts have since become important to the energy supply companies; this typically drives the creation of subsidiaries specialised in this type of business model.

The interviews showed that the complexity of compressed air contracting was underestimated by the electricity supply companies, especially with regard to the very high upfront and learning costs. Compressed air contracting has since become a "me too" product for electricity supply companies and is offered by almost all the larger and medium-sized utilities. However, only a few companies have already realised these types of projects and accumulated the necessary technical know-how. Among other things, these unexpected difficulties resulted in the temporary withdrawal of the supra-regional electricity supply companies from compressed air contracting and even the termination or sale of ongoing contracting projects.

The regional utility analysed in our sample was prepared to bear the considerable preliminary costs to develop its own expertise in this field and to build up strategic partnerships with compressor manufacturers and other companies. This utility lists a steady increase in sales from the new business model because of existing business contacts at the management level or within the purchasing department of the potential customers. These sales are especially important because all actors assume that the market for compressed air contracting will grow, albeit slowly. The utilities have a good reputation in power supply, however a much higher value can be realised from the sale of compressed air supply. Given the typically inflexible company structure and the cost framework in the supra-regional electricity supply companies only larger projects can be addressed. The attractiveness for the service provider increases with the option to supply also other media for the customer immediately or in the near future. The regional electricity company also realises smaller standardised projects in its supply area.

Service providers specialised in compressed air contracting or in contracting energy services usually have the necessary technical skills for customer-specific engineering. However, these providers use combinations of standard components, so that the customer-specific engineering only involves the overall system design while the standard components are assembled, connected and integrated into the existing infrastructure. The number of specialised compressed air service companies active on the German market is still small. Again, the high upfront costs before the first project is signed is frequently forming a barrier to market entry for firms offering new business models in the production of compressed air. The decisive obstacle here is not the cost of the investment in compressors and components, but the upfront cost and time for project acquisition. As a result of the generally low importance given to compressed air supply by industrial enterprises, despite its importance for their production processes, it usually takes 1–2 years from the first customer contact until the signing of the contract, but only a small number of first contacts will lead to a contract. During this business start-up period, wages must be paid for the staff needed for customer acquisition and the compilation of offers. Usually three to five members of staff are needed for a proactive canvassing, equivalent to costs of approximately 0.5–1 million Euros per year,

although it can be assumed here that the technical skills are already available in the companies. All of the compressed air systems realised by the questioned specialist service providers were financed with the help of a leasing bank.

As can be seen from the case of the examined company, the service providers in the field of compressed air contracting are usually companies that cannot pre-finance the investment using their own funds due to their size or financial resources, and they often do not have a sufficient credit line with their banks. Correspondingly, compressed air service companies need to involve a leasing bank to finance the compressed air system, unlike the regional electricity supply companies or compressor manufacturers, which can select a financing option depending on the size of the installation. In addition, this constraint means that the compressed air system needs to be on the balance sheet of the leasing company because it cannot be on the balance sheet of the service provider and the customer often enters into the new business model with the aim of keeping the compressed air system off from their balance sheet. Specialised service providers face a drawback as they are not familiar with the target industry and they cannot count on an existing network of sales staff compared to the compressor manufacturers and electricity supply companies, The key advantage of specialist compressed air service providers is that they are manufacturer neutral, and they usually have much higher flexibility and lower cost structures compared to the regional and supra national utilities.

The initiative for embarking on a new business model for compressed air supply almost always stems from the customers in the case of the compressor manufacturers. In the case of the electricity supply companies and the specialised service providers, however, it is almost always triggered by the company deciding to offer the new business model. The service providers contact potential customers and advertise their services, particularly the (cost) optimisation of the compressed air production, while accounting motives are typically of secondary importance. In contrast, compressor manufacturers highlight the greater relevance of accounting, although the optimisation of processes is often simultaneously pursued. For technical reasons, services to absorb capacity peaks in the compressed air supply do not play a role. Substitute compressors in case of significant compressor failures leading to longer outage times can be arranged for when necessary via short-term rentals.

For the acquisition of new customers, the electricity supply companies report the advantages of existing customer ties due to existing energy supply contracts. In addition, the supply companies have frequent contact with the management level/purchasing department/energy management, which are the appropriate points of contact for selling these types of energy service agreements. Because the power purchasing agreements last between approximately 1 and 3 years, both of the interviewed electricity supply companies use the renewal of the electricity supply contracts as an opportunity to discuss additional services. In addition, the electricity supply companies already have the relevant sales and marketing teams for the closely related product gas and electricity. Therefore, new sales structures do not have to be developed to sell operating schemes for compressed air, as the existing sales force can be used.

In contrast, the surveyed compressor manufacturers and specialist service providers tend to have contacts at the level of the technical managers or the works/plant managers. Admittedly, decisions are made at this level regarding the purchase of systems, but not about service and operating contracts. Even if these managers are involved in a decision, the final decision is usually not in their hands. Also this group of employees from the potential costumer is usually directly affected by the impact of outsourcing the compressed air supply; outsourcing shrinks their area of responsibility and would most likely reduce the number of their staff. These managers would therefore have a vested interest in not realising the operating schemes and the outsourcing of the compressed air function, and instead they would prefer to maintain responsibility for these tasks.

A considerable amount of groundwork must be performed up front by the service providers to obtain the technical information necessary to compile an offer, because potential customers are in most cases unable to formulate their requirements for the compressed air supply. In the first step, all the interviewed contracting providers conduct an analysis of the existing compressed air supply by installing measuring equipment at the existing compressor system, and they then analyse and evaluate the results. Because the design and planning of a compressed air system must be individually tailored to the demands of each potential customer, it is necessary for each provider to conduct the corresponding technical measurements to obtain the technical basis for making an offer. The analysis of the current situation must be accounted for as an acquisition cost by the contracting company because these costs are normally not reimbursed by the potential customer. If errors are made during this phase, they can have a considerable impact on the energy consumption of the system and thus its economic efficiency. After an offer has been made, the potential contracting customer usually does not have a pressing need to take a decision because they still have access to the existing and functioning compressed air supply, even if the existing plant is not energy- and cost-efficient. All the surveyed companies therefore agreed that often one to two years go by between the initial contact and the signing of a contract, during which time the ties to the potential customer must be maintained. For the companies just starting to offer compressed air contracting, this delay means that they need to account for having a first contract being signed one or two years after having started the business..

Acquiring projects in the field of compressed air contracting also requires more qualified staff than is required to sell air compressors, as the sales people not only need to understand a product, e.g., a compressor, but also need to have a deeper understanding of the economic impacts from the long-term business model including issues around insurance, liabilities, accounting rules and meter technology. The compressor manufacturers all agreed that the new business models can only be marketed by specially trained and educated employees. The costs for active marketing are therefore higher than for the traditional sales business. Potential customers must be interested in and informed about the new business model, because not all companies have heard of compressed air contracting before. Based on these framework conditions, contracting projects can only be presented as economically feasible if the total project cost is correspondingly high.

The surveyed companies assume that the required investment therefore needs to be above 100,000 Euro.

Only recently several providers have ventured for market offerings to provide contracting solutions for small and standardised compressed air systems, typically composed of a single compressor. One of the compressor manufacturers and one of the electricity supply companies offer contracting for small systems. The concept aims to reduce costs based on a standard solution that can be realised in a large number of units and for which the investments make up a larger share of the total life cycle costs. Simple invoicing using the number of compressor operating hours is performed in these cases. Both companies are still in the test phase for this product and cannot yet foresee whether the necessary and projected number of units can be realised in the market.

All the interviewed suppliers underlined that their customers do not regard compressed air supply as a core competence. Although the industrial customers usually have well qualified staff, especially in case of larger compressed air systems, wherever possible, these workers should not be tied up with routine tasks such as generating compressed air. The compressed air supply is frequently a low priority in these companies, as long as everything is running smoothly and there are no malfunctions.

Because the operation of the compressed air system is largely automated, know-how plays only a minor role according to the statements made by the companies. The providers believe that their know-how is very strong on the supply side, while the customer has strengths in compressed air distribution and application. Whether efficiency potentials can be tapped depends more on the correct planning and design than on operative know-how. The interviewed compressor manufacturers have advantages here compared to the other providers because they have more detailed data and knowledge regarding the weaknesses and strengths of their compressors and components; however, they might not be able to reach out for better suited products from a competitor if they have no equivalent product in their own portfolio.

The range of services supplied using their own staff or purchased from third parties and marketed in the overall package varies among the surveyed providers of compressed air contracting. Table 6.2 presents an overview of the service types that must be covered in a compressed air contracting project. The biggest value added in compressed air contracting is generated in the “production of compressed air compressors” and “electricity sales”. Correspondingly, it is easier for those types of companies to offer their own services to enter into new business models for compressed air. However, the manufacturers of compressors and components need to reflect on the sources of additional revenue and sales potential that can be tapped by entering into compressed air contracting. Compressors will be required regardless of whether the compressed air supply is provided by them or by another party. This model therefore only offers advantages for the compressor manufacturers if they are able to expand their compressor market share by using the new business models or if they can earn higher sales margins from providing services in comparison to simply selling the compressors.

Table 6.2 Services covered by own staff within the scope of operating schemes by supplier group

Task	Compressor manufacturer	Electricity supply company (supra-regional)	Electricity supply company (regional)	Service provider
Technical measurements to analyse the status of the existing installation of the customer	Yes	No	Yes, partly	Yes
Engineering of compressed air supply	Yes	No	Yes, partly	Yes
Production of compressors/ components of compressed air systems	Yes	No	No	No
Construction of piping and ventilation systems	Yes, partly	No	Yes, partly	No
Installation of compressed air system	Yes	No	No	Yes
Financing	No	Yes, partly	Yes	No
Controlling/invoicing	Yes	Yes	Yes	Yes
Maintenance	Yes	No	Yes, partly	Yes
Repairs	Yes	No	No	No
(Remote) Monitoring	Yes	Yes	Yes	Yes
Electricity supply	No	Yes, usually	Yes	No
Number of services covered in compressed air contracting per type of contract provider	8.5	3	6	6

By comparing the types of services offered by the surveyed companies, it becomes obvious that the absolute value added by the new business models is highest for the compressor manufacturers, while the potential growth achieved by embarking on this concept is the lowest. This result could be one explanation for the fact that the business models are pursued much more hesitantly by compressor manufacturers than other market actors. The only growth in the range of services from the operating schemes achieved by the compressor manufacturers stems from controlling and financing. While controlling is not a core business for the compressor manufacturers, it is managed in the interviewed companies using their own personnel; the financing is usually not performed by the manufacturer. Table 6.2 also shows that the supra-regional utilities only achieve a low value added in compressed air supply, but that the offer is frequently necessary in connection with the supply of other energy and media as desired by the customer. Therefore, the supra-regional utilities do not actively offer operating schemes in the field of compressed air supply without other synergies.

Very mixed results are obtained from analysing the extent to which the above operating schemes were economically successful. Five out of six providers of the new business model have had both positive as well as negative experiences with the operating schemes; one company only negative. This particular company is no

longer offering these types of operating schemes. The interviewed supra-regional energy supply company has changed its strategy several times based on its experiences in the market. After expanding its activities over a period of several years, large cut backs were then made to this field of business and at some point, selling the already realised projects to third parties was considered. Since then, the strategy has changed again and compressed air supply is once again being offered within the scope of multi energy delivery contracts for sites.

All the companies that participated in our work referred to massive price competition during acquisition. Despite this pressure, all the companies stated that they always designed the projects to achieve at least break even. However, the companies all also reported difficulties with the corresponding projects, especially if the framework data were not specified precisely enough or the compressed air demand altered significantly due to unexpected growth or closures. An extensive (usually non-standard) contract was necessary to complete the business transaction, which all of the providers considered to be difficult. However, all the providers tried to use standardised text modules as far as possible.

Overall, the group of compressor manufacturers, the group of utilities and the group of service providers all cited case examples that have been executed successfully and also cases in which a lesson was learnt the hard way. Finally, the economic success of the providers cannot be measured yet because the operating schemes for compressed air supply must first become more broadly established and the expected long-term developments in regards to compressed air demand, energy consumption and personal costs need to be confirmed by reality. Therefore, a comprehensive evaluation of success and failure appears to be feasible only after the end of the service contracts. At present, none of the suppliers have yet written off the start-up costs associated with the product development. The business concepts that were particularly successful were those with simple framework conditions and in which a significant energy and therefore cost savings could be realised. These conditions typically lead to a situation in which a win-win situation can be realised by reducing the costs for the customer while still leaving sufficient margin for the contractor.

6.5 Conclusions: Opportunities and Risks of New Business Models for Air Compressors

At least three different stakeholder groups are now acting as operators of compressors to supply compressed air to industrial customers: compressor manufacturers, utilities and specialist (energy) service providers. A wide range of companies are involved in this business because compressed air contracting was often established as a successful business model with a win-win option. The fact that the operation risk is manageable has also contributed to the reputation of the business model as being able to achieve low-cost remote monitoring and operation. A Win-win situation can be achieved for the providers of these compressed air operating

schemes as well as for the customers because of the significant and unexploited energy efficiency potential in the compressed air systems. Electricity costs are the primary cost factor in compressed air supply. As part of a study for the EU (Radgen and Blaustein 2001), an energy saving potential of approximately 33 % on average was determined for compressed air systems. Despite the large economic saving potentials and the "druckluft effizient" (2004) campaign sponsored by the German Federal Ministry of Economics, large sections of the industry still do not pay enough attention to the efficiency of their compressed air supply. Because the compressed air supply is not part of the core business, even profitable measures to improve the compressed air system frequently remain unrealised. This situation offers a great potential for promising offers in the field of compressed air contracting.

In all the supplier groups for this new business model, the regulations in the compressed air operating schemes are almost identical with regard to ownership, invoicing, staff, the operating site and exclusivity of use. There are only subtle differences between these items. Energy supply contracting is the typical concept underlying the operating scheme for air compressors. Despite the high existing energy saving potential in compressed air supply, which can be realised by the customer without own investment by a contracting solution, energy savings contracting has not achieved a breakthrough. Among other issues, this lack of progress can be ascribed to the fact that the required contract duration of 3–5 years requested by the industry does not allow for a full refinancing of the investment. In buildings, a contract duration of over 10 years is usually accepted for energy saving contracting by the contractees.

Although all six companies interviewed over the course of this work regarded operating schemes as a promising option, not all providers want to remain active in this business field. Some compressor manufacturers, in particular, show no increased interest in operating schemes because they see their competence as being in compressed air technology and do not believe that their sales opportunities are dependent on their ability to offer operating schemes. The drivers for the development of this business are more likely to be the financially strong, supra-regional energy supply companies and also the regional utilities, which see the chance to grow beyond their region's borders. In the wake of the power market's liberalisation, the energy supply companies have identified energy contracting as an important instrument for customer relationship management. Correspondingly, many supply companies are offering compressed air contracting, but without having developed it as an independent strategic business field. As a result, the number of companies offering contracting services is much larger than the number of companies that have already realised projects.

The total number of compressors that have been installed by compressor manufacturers within the scope of the new business models is very small compared to the total number of compressors produced by them. If an average of six compressors is assumed in a contracting system, the annual contracting volume is most likely still less than 150 systems or 1,000 compressors per year. This number is roughly equivalent to a market share of less than one percent of all the compressors sold in Germany.

Offering operating schemes for compressed air supply requires a high preliminary investment and qualified engineers. This business model is therefore primarily adopted by regional utilities and (energy) service companies. Individual compressor manufacturers are attempting to use the new business models to expand their market share. The supra-regional utilities and the majority of compressor manufacturers want to continue to work reactively in the future as well. If compressed air contracting gains a significant market share, increased price pressure could be exerted on the compressor manufacturers as purchasing power becomes concentrated in the hands of the contractors. There is also a risk that customers might see the compressor manufacturers as mere "commodity producers" if they do not want to offer the new business models. However, due to the low number of units expected in the contracting field, the impact will be not of relevance in the course of the next 10 years.

Building on the survey results, an attempt was made to determine the strengths and weaknesses of the individual groups offering operating schemes for compressed air supply. This analysis revealed that compressor producers profit from their extensive know-how and their prominence in the compressed air field. In addition, these producers usually already have a national service network at their disposal, which is necessary to manage the corresponding compressed air systems nation-wide. Detrimental for the producers is that they only consider their own products when planning. In addition, the company structure is not set up for longer term contracts; these contracts require a partial reorganisation of processes when embarking on these types of business models.

There are opportunities for compressor manufacturers accompanying the sale of their own products by providing service over the entire lifespan and the associated extensions of the chain, even if minor, to achieve additional value. For these compressor manufacturers, risks result from the framework condition because larger companies tend to outsource the energy and media supply together; their service offers focussing on compressed air alone are therefore too limited for these customers.

Looking at the supra-regional energy supply companies, their biggest strength are the contacts they have at the management level of the potential customers for compressed air contracting. The power supply contracts provide them with the opportunity to contact customers. Due to the economic pressure on the utility companies from the liberalised electricity market, they need to develop additional business fields. To enter into these, projects without a profit margin were acquired in the past with the objective of winning prominent reference clients. Their market competitors are particularly the compressor manufacturers which are more experienced, in the analysis of the current compressed air systems and can provide better insights into the technical details of the systems. A significant weakness of the supra-regional utilities is the lack of specific compressed air know-how, which results in dependencies on third party suppliers. Risks also exist for the supra-regional utilities regarding their somewhat negative image in terms of service orientation, flexibility and cost structure. Compressed air supply becomes attractive

for supra-regional utilities when synergies and cross sales can be achieved with the supply of other energy carriers.

In comparison, the regional utilities win recognition for their "proximity to home" and for being well known in their regions. However, these advantages shrink if the companies want to expand their markets outside of their supply region. Nonetheless, compressed air contracting projects may be one route to expanding supra-regional marketing of other energy products for the regional utilities, especially power. For smaller utilities, however, this expansion also harbours the risk of a lack of professionalism in planning and implementation.

Specialised compressed air service providers usually have good knowledge of the compressed air market. These providers know and understand the details of the technical systems and are familiar with the needs of industrial customers in this field. They profit from the industry's tendency to focus on core business matters, but they sometimes suffer from lacking staff qualifications and the long lead times needed to acquire compressed air contracting projects. Compressed air service providers are also challenged because they are not broadly known in the manufacturing industry.

Because the overall demand for compressed air systems does not depend on the type of operating mode/ownership, only minor job effects are expected in the field of compressor production. Additional jobs could be created in sales and marketing and engineering because the marketing of operating schemes is more complex. Careful planning is needed to exploit the energy savings potential in compressed air generation.

Business opportunities will arise for all market actors due to the growing market for contracting in Germany and the European Union; however, this market is growing more slowly than originally predicted. The presented analysis of the strengths and weaknesses reveals that the biggest opportunities for the successful implementation of new business models for compressed air supply can be expected for compressor manufacturers and energy supply companies, but only if these firms actively work the market. Therefore, sufficient business potential for specialised service providers in the market is expected, if they get a head start and behave proactively.

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