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Doubling rail freight's market share

Re-railing freight rail business back to success

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Foreword

The current division of labour between the modes in freight transport has developed as an evolutionary process over past decades. In 2018, the share of rail in total freight transport in the EU countries measured in tonne-km remained constant at around 18%, with individual values ranging from 0% to just under 30%. The differences can be explained historically – countries of the former Eastern bloc still have a higher share of rail today. This stems from the socialist ideology and planned economy in which rail freight was favoured over road due to state stipulations. However, after the dissolution of the Eastern bloc, a convergence to the transport structures of the Western countries was noticeable. The development of value-added structures in the national economies has also played an important role. Basic industries with their simple transport structures for heavy bulk goods have a greater affinity to rail freight logistics than the complex transport tasks for industrial and consumer goods.

Overall, however, this raises the question of why all the attempts and efforts of EU governments to increase the modal share of rail have had little success. This is the basic question and it needs to be understood why the share of rail has fallen from approx. 60% in the 1950s to the above-mentioned value. Only then can one meaningfully consider whether and, if so, what greater role rail can play in future freight transport. This question, too, must be discussed with an open mind to avoid circular reasoning and ideologically based prejudices. Rail, like all other modes of transport, is neither a good nor a bad means of transport, nor does it have a better environmental balance per se, as many people today think. It has strengths and weaknesses that are systemic and must be taken into account in all considerations about its use.

The strength of rail is clearly efficient mass transport. For all other transport tasks, rail is not predestined and does not make economic sense. Only if it is possible to combine such tasks is the extremely high expenditure for the railway infrastructure worthwhile, especially in demanding topographical terrain. This statement applies to both passenger and freight transport. Determinations such as those in the former Eastern Bloc, where freight had to be carried by rail for distances from 50 km upwards, had little relation to reality. Together with other misjudgements, these contributed to the collapse of the Eastern European economic and social systems. No one should therefore be interested in repeating this painful experience.

It is often argued that the railway has a glorious past and dominated land transport 100 years ago and that the transport needs of the industrial societies of that time could obviously be met. However, this argument is purely descriptive and of no value because, on the one hand, the transport needs of that time should not be equated with those of today's extremely labour-divided service and industrial societies. Secondly, there was no efficient road transport back then as we know it today.

Today's structure of modern economies would be inconceivable without very flexible and scalable road transport. And the underlying transformation process from an industrial society with a strong concentration of value creation to today's small-scale and highly labour-divided value chains was, along with technical innovations, the central driver of prosperity. Today's factory logistics are much more fragmented than they were 70 years ago. It often has more the character of general cargo transport because only partial loads are transported to the individual destinations.

As early as the 1920s, it was pointed out that in the right circumstances road transport could handle freight transport needs more effectively and also more efficiently than rail. It could also better adapt to the rapidly changing demands of the national economy. With the continued rigidity of rail freight in the traditional production processes, which were essentially based on continuous train formation and reformation, its demise was predicted. This is what frequently happened, as we know today.

Yet this source – which from today's perspective can almost be called historical – already gives an indication of where to look for the reasons. This is in order to understand the interrelationships and the development of the past decades. It is the adaptability to the changing needs of a constantly developing national economy that is brought about by anonymous market forces. And in this respect, the wheel-rail system obviously has both practical and structural limits, so that not every transport task can be taken over by rail.

Incidentally, railwaymen had realised this even earlier and repeatedly over the last 150 years. This led, for example, to the founding of the bus and truck manufacturer Büssing in 1903 (taken over by MAN in 1971) by Heinrich Büssing, the former technical director of the signal construction company Max Jüdel & Co., now part of Siemens Mobility Rail Automation. The decision of the then Reichsbahn to take over road haulage by acquiring the Schenker haulage company in 1931 must also be seen in this context. Both considerations were based on the realisation that the railways were bound by the confines of their costly and established networks and that further expansion and onward carriage was therefore likely to take place by road. This required at this times already the appropriate means of land transport (trucks) and a correspondingly continuous logistics concept on the base of consolidated shipments, which the Schenker company had already established from 1873 onwards by using all means of transport.

The standardisation of ISO-container in 1961 has tremendously improved the efficiency of international transport, especially seaborne transport. The railways adapt wagon concepts for these standardised boxes so that they could implicitly hold market share in part-load traffic, for which the container can be seen is the representation of the consolidated shipment. It should be noted that several boxes of smaller size where in use for railways already in the 19^{th} century to make load change to rail more efficient, but no standard could be established. However, today's so called combined traffic is more or less the logical and by far more efficient successor of the consolidated shipments by train in the past. By no accident this has been the fastest growing transport mode on rail in the last five decades. This recognition provides further indication how to develop the rail freight transport system further.

This book concentrates on how the strengths of rail can be used in today's land transport logistics chains and what must be done to ensure that this can lead to a valuable contribution to the national economies. The focus is on making rail more prominent in the principal freight transport chains and thereby achieving a positive market impact.

The approach is to enable the railways to increase their competitiveness through their own actions. It includes improvements in the methods of service production and in the train and wagon concepts used. The aim is to align the railways more closely with what the market demands. In this context, it is necessary to assess the anticipated innovations in road freight transport such as partially or fully autonomously operating vehicles.

There may well be further significant efficiency gains, as well as a continuously improved environmental balance of road freight. Any forward-looking concept for the railways needs to reflect what their competitors might do and counter that wherever possible.

Development in such matters does not end today, or even tomorrow!

Contents

1 Where does rail freight stand today – a critical stocktaking

1.1 Development of freight traffic performance

According to the European Commission's White Paper on Transport published in 2011, freight shipments over short or medium distances (below about 300 km) will to a considerable extent remain on trucks. More than half of all goods in road transport in terms of weight are moved less than 50 km and more than three quarters below 150 km.

Furthermore, the Commission says that the options for road decarbonisation are more limited in longer distances, and freight multimodality has to become economically attractive for shippers. Efficient use of different modes on their own or in combination is needed. The EU needs specially developed freight corridors optimised in terms of energy use and emissions, minimising environmental impacts, but also attractive for their reliability, limited congestion problems and low operating and administrative costs.

For this reason, optimising the performance of multimodal logistic chains, including making greater use of more energy-efficient modes, such as waterborne and rail, is one of the main objectives of the EU formulated in the White Paper on Transport. "30% of road freight over 300 km should shift to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050, facilitated by efficient and green freight corridors. To meet this goal will also require appropriate infrastructure to be developed."

But if one considers the development of the main performance indicators – the transport performance in tonne-km and transport volume in tonnes – of the freight sector in the last decade, one cannot not see any significant increases in the rail freight business. After an all-time high in 2008 and a heavy decline due to the world finance and then world economic crisis in the following years, rail freight could not connect to the positive development of the early 2000s. The transport performance has levelled out at around 420 billion tonne-km. The transport volume reached 1.695 million tonnes in 2015, which was at the same level as 2004 and around 4% lower than the average of 12 years.

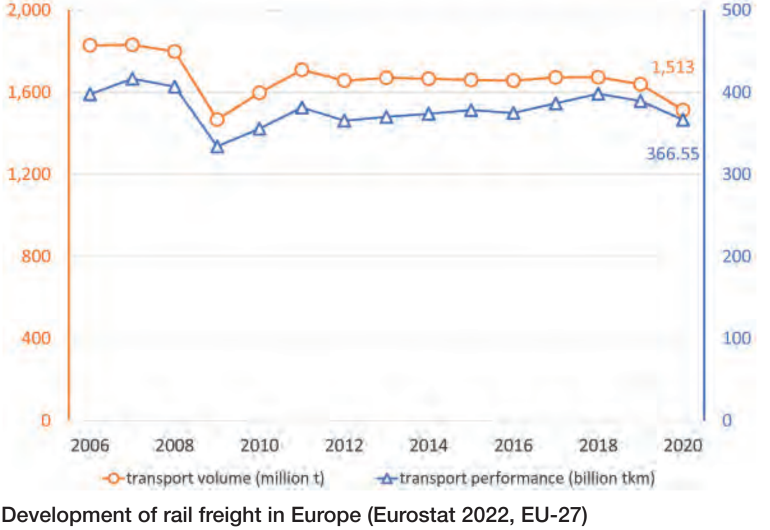


Figure 1.1: Development of rail freight in Europe (Eurostat 2022, EU-27)

Taking the modal share in tonne-km into account, it becomes obvious that the market share of rail freight is stagnating at a level of around 18 percent of the total (see Figure 1.2). It appears that rail freight transport has been driven into a niche, which is not attractive enough for road transport or cannot be served for legal or other reasons.

Considering that the measurement unit of tonne-km should favour the bulk movement of heavy goods, then the situation for rail is even worse than the official statistics indicate.

Freight rail transport has survived in the various rail affine market segments. These will partly lose its relevance and meaning in the transformation to post-industrial societies in Europe.

Overall, given the financial performance of the still dominant state owned freight rail operators in Europe, the picture does not give any indication of a stable situation. Different from what one can expect the bottom line of the operations show losses all over Europe. “Although under tremendous financial stress, the incumbents are notorious for failing to push through radical changes and running their businesses profitably”. Rail freight business in its present form must therefore be co-financed by the taxpayer. Only the private sector in the freight rail business is profitable in certain niche segments.

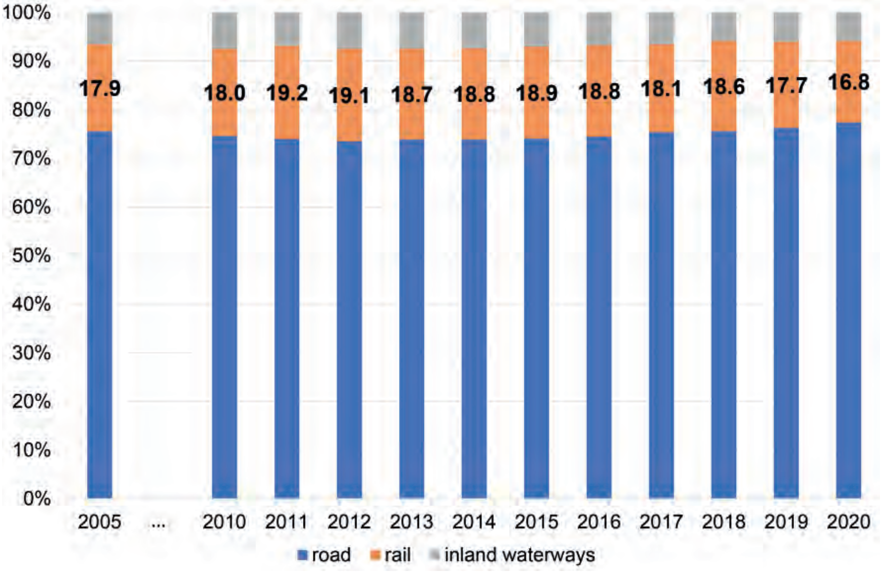


Figure 1.2: Development of modal split of land-based freight transport in the EU (Eurostat 2022, EU-28)

1.2 Operations and competitiveness in transport business

This chapter deals mainly with the current state of the railways – not only in terms of costs but also the services offered by the sector as a whole. It outlines some trends in the transport sector and customers’ requirements or expectations of rail freight. Since the additional market shares must be won from road, the importance of low density, high value goods (LDHV goods) is described and comparisons are also made with road freight logistics where appropriate. Research results from previous projects will also be used.

4 A competitive freight train concept – the CFW freight wagon

The extended market wagon (EMW) is a wagon concept that is embedded in a fixed train formation. It enables highly efficient rail freight transport, and thus becomes the partner of the road in the main leg of the transport route. It relies exclusively on the intermodal approach with containers and swap bodies. It does not claim to cover the complete transport journey (door-to-door), but focuses on the main element, which takes place between terminals that form the entry and exit points to the rail transport system for the containerised goods transport.

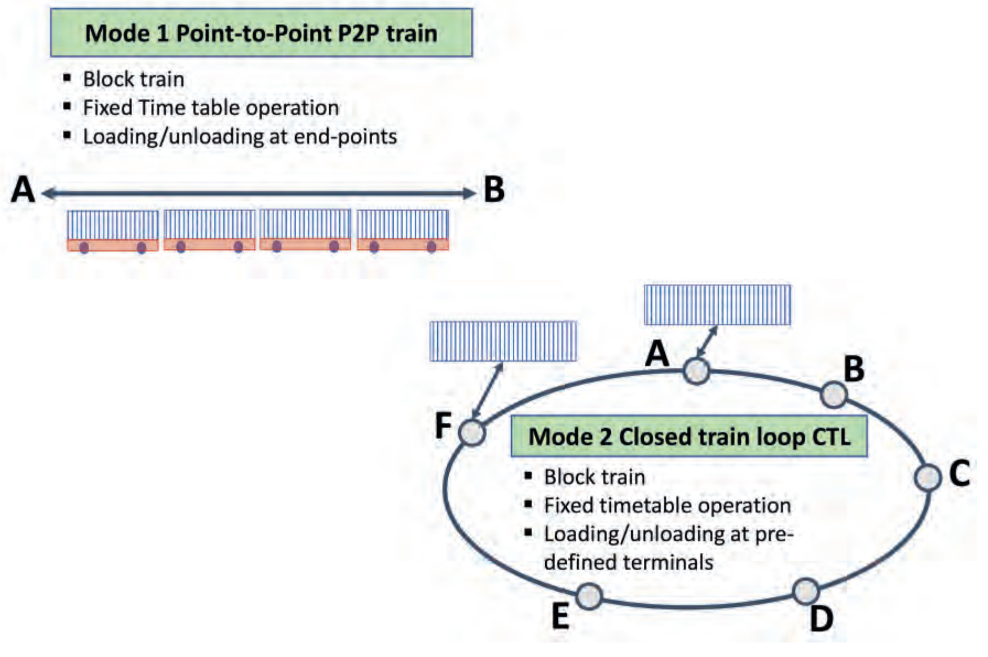


Figure 4.1: Production modes for intermodal applications with EMW

The specifications of the EMW can be developed from this basic concept. Due to the strict block train concept, this results in a different approach than is usually the case with the specification of freight wagons. The EMW is a wagon that only has to operate with vehicles of the same type in a formation. The compatibility requirements of the UIC system, where every new wagon must be compatible with every other wagon already in use, are not necessary for the EMW due to the consistent production approach. This means that the main innovation hurdle in the current UIC freight wagon system is removed. It also removes essential parts of the requirements from the UIC leaflets, which were included in the European interoperability directives as Annex C a few years ago. The latter are not relevant for the proposed specification.

4.1 Wagon types and train configuration

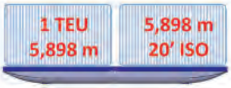
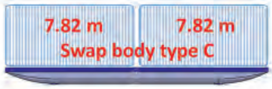
Application	Wagon type	Transport capacity	Length over coupler	Platforms per train	Units per train
Overseas container TEU	**CFW-EMW 1**	 1 TEU 5,898 m / 5,898 m 20' ISO	**12.7 m**	**56**	**112 TEU**
Swap body type A 45' road transport	**CFW-EMW 2**	 13,556 m Swap body type A 45'	**13.3 m**	**50**	**50 SWB A 45'**
Swap body type C 7.15 – 7.82 m road transport	**CFW-EMW 3**	 7.82 m / 7.82 m Swap body type C	**16.5 m**	**44**	**88 SWB C**

Figure 4.2: Wagon types and applications

The CFW concept for intermodal applications does not rely on a uniform wagon type, but provides for a series of three fundamentally compatible variants that are realised from a modular system. The reason for this is that containerised transport is already carried out with different container formats. A rough distinction can be made between pure land transport and overseas transport, where land transport only comprises part of the transport route. In the latter, ISO containers in 20‘ or 40‘ dimensions dominate. In pure land transport, on the other hand, swap body systems have become established which are either adapted to the trailer concept and measure 45‘ in length or are intended for transport with so-called articulated trains and have lengths of 7.15, 7.45 or 7.82 metres. Although it is geometrically possible to define a vehicle platform that can transport all these containers, this is not envisaged in the CFW concept for the EMW because this means that the transport capacity of the train length cannot be utilised optimally and the relatively large gaps between the containers worsen the environmental balance and economic efficiency.

Since the transport can be separated in principle and the P2P and CTL production concepts are intended to transform the transport sector in such a way that longer transport distances are handled by rail, i.e. the modal split is shifted in favour of rail. It is not important to continue the current situation in combined transport into the future, but primarily to make an attractive offer to the transport market for the intended main run on rail. For this reason, the so-called port-hinterland traffic is separated and served with its own variant designed for the transport of ISO containers, the CFW-EMW 1 (see Figure 4.2). For pure land transport, the focus will be entirely on swap bodies, whereby the different truck configurations mentioned will be taken into account and the transport of swap bodies of the A and C types will be served by different variants of the CFW-EMW. The market will then regulate the demand for the CFW-EMW 2 and 3 variants via its self-optimisation. In all likelihood, both concepts will remain on the market, just as they do today. In Southern Europe, trailer transport with A types is preferred, in Central Europe it is the articulated trains that are used for containerised transport with truck-truck transhipment using C types.

The trains can be configured in any way from these variants. However, it is likely that in future pure land transport only variants 2 and 3 will be used in trains, and there in a pure form, while

6 Migration as a complex process for rail freight

6.1 Rationale of migration

The research activities in IP5 are diverse and cover all technical assets that are required for sustainable rail freight transport. These include the vehicle technology of locomotives and freight wagons as well as infrastructure facilities.

The portfolio of IP5 consists of innovations of different scope, which can be characterised as either evolutionary, bridging or revolutionary in relation to the current rail freight system in Europe.

The developed solutions as the technical outcome of IP 5 vary regarding:

- the potential for substitution of the current system
- the investment scope and volume (capex in infrastructure and/or rolling stock)
- the need for public financial support (subsidies) and
- the degree of compatibility with the current system and its components (see Figure 6.1).

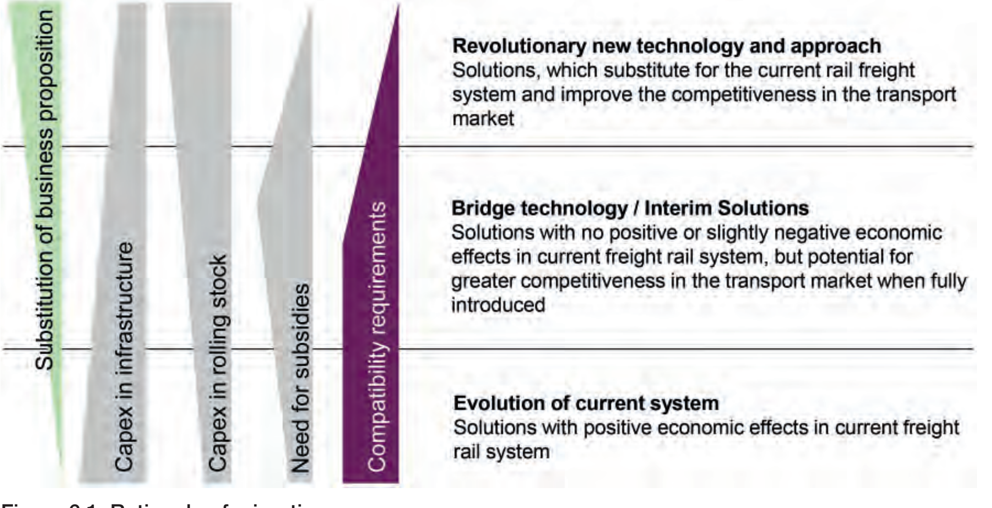


Figure 6.1: Rationale of migration

The need for subsidies seems to be necessary for bridging technologies. Their benefit cannot be realised with the current systems due to the boundaries that remain or at least not during the migration phase. The full potential requires a completed roll-out of the technology.

The evolution of the current freight system will improve the production of transport services. This approach will contribute values to the freight rail system, especially on the short- and mid-term perspective. Although they will not be enough for rail to become competitive with road transport, these innovations should strengthen rail freight in the transition to the "production system for the future". The large financial advantage is the reduced need for subsidies as most of the measures will have a short payback time.

Finally, the revolutionary approach does not depend that much on subsidies because this approach intends to implement a new freight rail system in parallel to the existing one, with a different functional distribution between infrastructure and rolling stock. More decisively, it will offer a different perspective of the transport market. It is not the case of doing better within the boundaries of the current system is the guideline, but how the railway system can again become competitive with the modern road transport system. The revolutionary approach cannot be mixed with the current operational methods as the meaning will not be compatible. Its introduction must follow a separate path, which should start with block train operations with dedicated locomotives – comparable to today‘s multiple unit concepts in passenger transport.

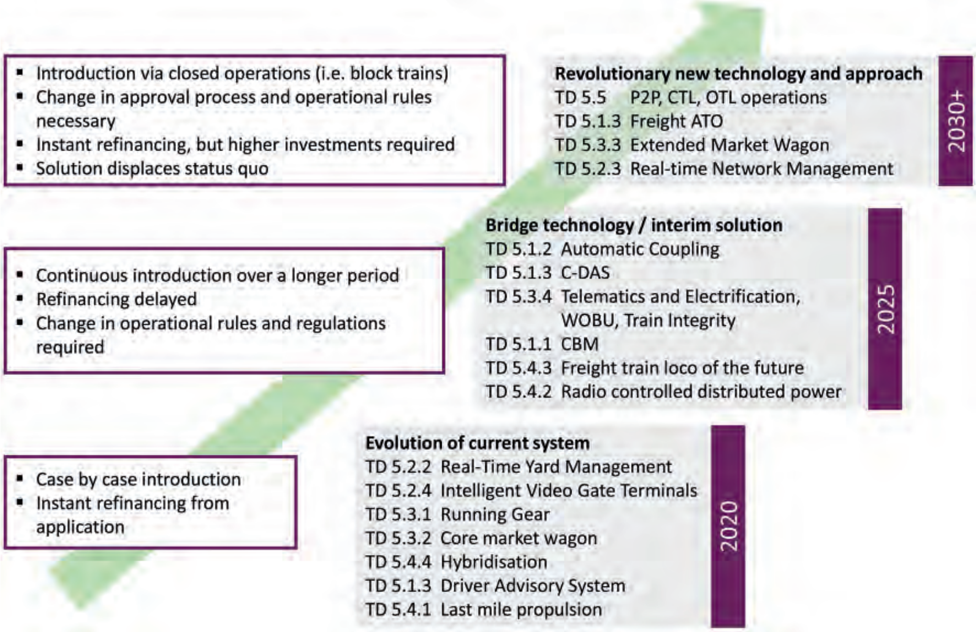


Figure 6.2: Application of migration rationale to IP5 activities

6.2 Innovation portfolio and logical order

The innovation portfolio comprises seven core technical solutions, supported by and partly dependent on 10 technologies at sub-system level (see Figure 6.3):

Automated freight train

- Autonomous wagon for SWL
- Freight train loco of the future
- Extended market wagon
- Core market wagon
- Real-time network management
- Real-time terminal management
- Intelligent video gate terminal

and the operational modes for a highly efficient production system of rail freight in the future (FR8RAIL D1.2). The benefits for the forwarder will be driven by these core technologies.

Lack of accessibility and reliability results in poor service quality of rail freight. Freight transport requirements have grown enormously over the last half century, and that seems likely to continue. Road has found the right answers to this, rail has not. And the volume moved by rail has remained largely static and is now no more than 20% of total inland movements. Why should this be so, and what should be done to exploit the full potential of rail's mass transport?

The European Commission's White Paper of 2010 envisages shifting large transport volumes to rail, using not only technological innovation, but also by establishing new, market-driven and highly efficient production concepts.

The benchmark is modern road freight logistics, which have improved enormously. These operators always put the customer at the centre of their businesses. Road also dominates the transport segments which could offer significant growth and additional market share for rail.

The authors have investigated how rail freight transport can be reviewed systematically and made fitter for the future. They analyse the different types of goods, their growth potential, and how they might fit into a future overall system of rail freight. That includes the development of new production concepts and a radical freight train concept using the *CFW Extended Market Wagon*.

Considering the economic and financial capabilities of the rail sector, the authors propose a two-path migration approach. This consists of an evolutionary path where previous production concepts are improved using new solutions, followed by the revolutionary approach using new style wagons with highly automated components in fixed train configurations. Higher running speeds and an overall more dynamic operation would enable them to be fitted more easily into the timetable.

The proposed package outlines a way towards sustainable competitiveness, the possibility of vastly expanded rail freight businesses, and an even more dynamic future.

Extra: Free e-book included. Users who have a PDF reader installed on their device (PC, tablet, smartphone) can access the content of the book electronically including a search function.

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