Anticipated acquisition by Thermo Fisher Scientific Inc. of the electron microscope peripherals business of Roper Technologies, Inc.

Decision on relevant merger situation and substantial lessening of competition

ME/6773/18

The CMA's decision on reference under section 33(1) of the Enterprise Act 2002 given on 19 December 2018. Full text of the decision published on 21 January 2019.

Please note that [✂] indicates figures or text which have been deleted or replaced in ranges at the request of the parties or third parties for reasons of commercial confidentiality.

SUMMARY

1. On 24 April 2018, Thermo Fisher Scientific Inc. (**Thermo Fisher**) agreed to acquire the electron microscopes peripherals business (the **Target**) of Roper Technologies, Inc (**Roper**) for approximately $925 million (the **Merger**). The Target business consists of the entire share capital of several Roper subsidiaries, as well as certain other associated assets and liabilities of Roper. The Target business is operated under the "Gatan" brand. Thermo Fisher and the Target are together referred to as the **Parties**, and, for statements referring to the future, the **Merged Entity**.

2. The Competition and Markets Authority (**CMA**) believes that it is or may be the case that each of Thermo Fisher and the Target is an enterprise; that these enterprises will cease to be distinct as a result of the Merger; and that the share of supply test is met. Accordingly, arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation.

3. The activities of the Parties are vertically related as the Target is active upstream in the supply of peripherals to the manufacturers of electron microscopes (**EMs**) and Thermo Fisher is active in the downstream market for

the sale of EMs with peripherals. The Target supplies Thermo Fisher with cameras, filters and sample holders. On some rare occasions, Thermo Fisher also buys specimen preparation products and detectors from the Target.

4. The Parties also overlap in the supply of peripherals (eg specimen preparation products, cameras and detectors) for use with EMs. The Target supplies peripherals to EM manufacturers and on some occasions (such as on the aftermarket) to end-users. Thermo Fisher sells specimen preparation products as standalone products, and supplies other peripherals either with its EMs or to customers who already have a Thermo Fisher EM.

5. The CMA has found that there is limited demand- and supply-side substitutability between the different peripherals upstream, and between the different EMs (ie Transmission EMs (**TEMs**) and Scanning EMs (**SEMs**)) downstream. Furthermore, the relevant competitor set and the competitive conditions for the supply of TEMs and SEMs vary depending on which peripherals the end-user needs. Therefore, the CMA has assessed the impact of the Merger using the following frames of reference:

   (a) Upstream, the supply of the following products to EM manufacturers worldwide:

      (i) Filters

      (ii) Direct Detection (**DD**) cameras

      (iii) General Imaging (**GI**) cameras

      (iv) 3D ultramicrotomes

      (v) Other specimen preparation products

   (b) Downstream, the supply of the following products worldwide:

      (i) TEMs with filters

      (ii) TEMs with DD cameras

      (iii) TEMs with GI cameras

      (iv) TEMs with other specimen preparation products

      (v) SEMs with 3D ultramicrotomes

      (vi) SEMs with other specimen preparation products

6. The CMA has found that the Parties each have significant market power in their respective fields. Thermo Fisher has a share of supply of [60-70]% in the supply of TEMs worldwide, [80-90]% in the supply of TEMs sold with filters, [70-80]% in the supply of TEMs sold with DD cameras and [60-70]% in the supply of TEMs sold with GI cameras; while the Target is the only non-vertically integrated supplier of filters globally, and in recent years has had a [40-80]% share of supply in DD cameras[1] and a [50-70]% share of supply in GI cameras[2].

7. The CMA has considered both a vertical theory of harm and a horizontal theory of harm.

8. For the vertical theory of harm, the CMA considered whether the Merger would give rise to vertical effects through the Merged Entity having the ability and incentive to engage in total or partial foreclosure strategies by denying both current and future rival EM manufacturers access to the Target's peripherals, or permitting access but on less good terms. In this document, the term 'input foreclosure' refers to either partial or total foreclosure unless stated otherwise.

9. The Target is the only non-vertically integrated supplier of filters to EM manufacturers[3]. The Target is also the leading supplier of DD cameras and GI cameras to EM manufacturers and its products are generally considered to be of a higher specification and quality than those of its rivals. Many end-users rely on the Target's filters, DD cameras and GI cameras for use in scientific research in both life sciences and material sciences.

10. Based on the evidence received, including extensive third party concerns from Thermo Fisher's customers and competitors, the CMA has found that the Merged Entity may have the ability and incentive to foreclose competing TEM manufacturers from access to the Target's filters, DD cameras and GI cameras with the aim of diverting sales to Thermo Fisher's TEMs.

    (a) Ability: The CMA has found that the Merged Entity would have the ability to foreclose competing EM manufacturers. This is supported by evidence showing that the Merged Entity will have market power upstream (with high shares in the supply of filters, DD cameras and GI cameras), and

---

[1] Annex 1 to the Parties' Response to RFI, dated 21 September 2018 (**RFI 2**). Excluding self-supply. When self-supply is included, the Target's share is between [20-60]% worldwide and the Parties' combined share is between [70-90]% worldwide.
[2] Annex 1 to the Parties' Response to RFI 2. Excluding self-supply. When self-supply is included, the Target's share is between [30-50]% worldwide, and the Parties' combined share is between [60-80]%.
[3] JEOL also supplies an in-column energy filter for use with its own EMs but does not supply to other EM manufacturers.

that the Target's filters, DD cameras and GI cameras are important to the Merged Entity's downstream competitors.

(b) Incentive: the CMA has found that the Merged Entity would have the incentive to foreclose competing EM manufacturers due to the Merged Entity's high margins in the supply of TEMs in comparison to its margins in the supply of filters, DD cameras and GI cameras.

11. The effect of this foreclosure would be to enhance Thermo Fisher's market position in TEMs, where it is already very strong, reducing its incentive to innovate, increasing prices and reducing service and quality for customers.

12. The CMA therefore believes that the Merger gives rise to a realistic prospect of a substantial lessening of competition (**SLC**) as a result of vertical effects arising from foreclosure in the supply of filters, DD cameras and GI cameras to competing TEM manufacturers at a worldwide level.

13. For the horizonal theory of harm, the CMA considered whether the Parties compete directly in the supply of DD cameras to TEM manufacturers and, more specifically, whether the Target's DD camera competes with Thermo Fisher's DD camera, either when supplied with a Thermo Fisher TEM, or to customers who already have a Thermo Fisher TEM (given that Thermo Fisher self-supplies its DD camera and does not supply its DD camera to other TEM manufacturers).

14. The CMA has found that the Merged Entity will have a high combined share in the supply of DD cameras ([70-80]%, including Thermo Fisher's self-supply), with only one other supplier of DD cameras remaining after the Merger. The Merger would eliminate competition between the Parties to appeal to end-users with lower prices or better quality or service, with very limited alternatives available. In particular, post-Merger the Parties may have less incentive to innovate. For these reasons, the CMA believes that the Merger gives rise to a realistic prospect of an SLC as a result of horizontal unilateral effects in the supply of DD cameras for use with TEMs worldwide.

15. The CMA did not find an SLC in relation to any other frame of reference in which the Parties overlap or in which their products are vertically related.

16. The CMA is therefore considering whether to accept undertakings under section 73 of the Enterprise Act 2002 (**the Act**). The Parties have until 28 December 2018 to offer an undertaking to the CMA that might be accepted by the CMA. If no such undertaking is offered, then the CMA will refer the Merger pursuant to sections 33(1) and 34ZA(2) of the Act.

ASSESSMENT

Parties

17. Thermo Fisher is a US-based corporation listed on the New York Stock Exchange. Thermo Fisher is a global manufacturer of a broad range of analytical instruments, scientific equipment, consumables, services and software for research, analysis, discovery and diagnostics. As part of its activities, Thermo Fisher manufactures EMs through its wholly-owned subsidiary FEI Company (**FEI**), which it acquired in 2016. Thermo Fisher supplies both TEMs and SEMs for use in both life science and material science applications. These types of EM vary in price and functionality. Thermo Fisher also supplies EM peripherals (ie cameras and detectors), both with its EMs and separately to customers who already have a compatible Thermo Fisher EM. The turnover of Thermo Fisher in the last financial year was approximately £16 billion worldwide, of which approximately £[✂] was generated in the UK.

18. The Target is a US-based manufacturer of technological equipment. The Target business manufactures and supplies EM peripherals globally under the Gatan brand, including:

    (a) Filters;

    (b) Cameras (both DD cameras and GI cameras);

    (c) Detectors (both Bright Field/Dark Field Detectors (**BF/DF Detectors**) and Cathodoluminescence Detectors (**CL Detectors**));

    (d) Sample holders; and

    (e) Specimen preparation kits, including 3D ultramicrotomes (ie a specimen preparation product used to slice samples and, through a remote detector and associated software, capture 3D images).

19. The turnover of the Target in 2017 was approximately £[✂] worldwide, of which approximately £[✂] was generated in the UK[4].

Transaction

20. On 24 April 2018, Roper signed an agreement to sell the Target to Thermo Fisher. Under this agreement, Thermo Fisher will acquire the entire share

[4] The CMA notes that the Target received additional revenue from sales to customers based outside the UK for resale to end-users based in the UK.

capital of several Roper subsidiaries as well as the assets and liabilities associated with the Target business.

21. The Parties informed the CMA that the Merger had also been the subject of review by competition authorities in Austria and the USA.

22. The Parties submitted that they operate highly complementary businesses and that the Merger will allow Thermo Fisher to drive its earnings growth by acquiring a profitable business with the potential for further growth. Thermo Fisher said that being able to supply the Target products to other EM manufacturers will increase Thermo Fisher's ability to benefit from growing demand for EMs. The Parties' internal documents also indicate a number of other factors driving the rationale, including:

    (a) that the Merger [✂][5]; and

    (b) the ability to [✂]"[6].

23. The Parties submitted that the Merger will advance TEM microscopy in several ways to the benefit of scientific research in the UK and the rest of the world[7], including [✂], facilitating and advancing cutting-edge science, increasing the number of experiments that can be completed and improving support services for end-users[8]. The Parties said that, [✂][9].

Procedure

24. The Merger was considered at a Case Review Meeting[10].

Jurisdiction

25. Each of Thermo Fisher and the Target is an enterprise. As a result of the Merger, these enterprises will cease to be distinct.

---

[5] Attachment D2 to the Parties' Merger Notice.
[6] Attachment D9 to the Parties' Merger Notice.
[7] Section 3 of the Parties' Response to the Issues Letter, 29 November 2018.
[8] Paragraph 3.4 of the Parties' Response to the Issues Letter, 29 November 2018.
[9] In particular, the Parties submitted that the ability to deliver a fully integrated EM system to end users will result in substantial benefits, including: (a) improving the manipulation of images; (b) facilitating real-time data management; (c) reducing time-to-result; (d) increasing data reliability; (e) reducing the knowledge and experience required to use EMs, thereby lowering the cost of using an EM and broadening the potential market; (f) enabling Thermo Fisher to offer EMs at a lower cost due to the elimination of the double margin on EMs that contain peripherals supplied by the Target; and (g) enabling Thermo Fisher to provide a 'one-stop-shop' support service when something goes wrong with an instrument (as Thermo Fisher will be responsible for all the integrated componentry).
[10] See *Mergers: Guidance on the CMA's jurisdiction and procedure* (CMA2), January 2014, from paragraph 7.34.

26. The Parties overlap in the supply of cameras for EMs, with a combined share of supply of [70-80]% (increment [20-30]%) on the basis of revenues generated in the UK from the supply of both DD cameras and GI cameras.

27. The CMA therefore believes that it is or may be the case that arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation.

28. The initial period for consideration of the Merger under section 34ZA(3) of the Act started on 25 October 2018 and the statutory 40 working day deadline for a decision is therefore 19 December 2018.

Counterfactual

29. The CMA assesses a merger's impact relative to the situation that would prevail absent the merger (ie the counterfactual). For anticipated mergers, the CMA generally adopts the prevailing conditions of competition as the counterfactual against which to assess the impact of the merger. However, the CMA will assess the merger against an alternative counterfactual where, based on the evidence available to it, it believes that, in the absence of the merger, the prospect of these conditions continuing is not realistic, or there is a realistic prospect of a counterfactual that is more competitive than these conditions[11].

30. The CMA has found no evidence supporting a different counterfactual, and the Parties and third parties have not put forward evidence in this respect. Therefore, the CMA believes the prevailing conditions of competition to be the relevant counterfactual.

31. Since announcing the Merger, the Parties have entered into long-term agreements for the supply of the Target's peripherals for use with EMs with their two main rivals in the supply of TEMs (JEOL and Hitachi). The Parties have submitted that these agreements are in its commercial interests; however, the CMA understands that the agreements were prepared mindful of competition authority scrutiny and are conditional on completion of the Merger. As these agreements would not exist in the absence of the Merger, they are excluded from the counterfactual. However, the CMA has considered their impact on the ability of the Merged Entity to foreclose its downstream EM competitors within its competitive assessment (see paragraph 89 onwards).

---

[11] *Merger Assessment Guidelines* (OFT1254/CC2), September 2010, from paragraph 4.3.5. The *Merger Assessment Guidelines* have been adopted by the CMA (see *Mergers: Guidance on the CMA's jurisdiction and procedure* (CMA2), January 2014, Annex D).

Background

32. Thermo Fisher is active in the production and supply of EMs, through its subsidiary FEI. EMs use electron beams to produce an image of a specimen, resulting in greater magnification and resolving power than a traditional microscope using visible light.

33. EMs are used by, among others, universities, research institutes and industrial companies in a wide array of sectors, including semiconductors, tissue imaging, toxicology, forensics, food science and pharmaceuticals[12].

34. EMs are typically procured by end-users via a tender process. The end-user, eg a university, will issue an Invitation to Tender (**ITT**), setting out its specific needs. The CMA has heard that the number of bids in response to these ITTs tends to be low (approximately 2-5) and that not all of those bids will be credible given the end-user's precise requirements. The life of an EM is typically around 10 years, although can be longer.

35. EMs are expensive products and are procured relatively rarely. The average price of a TEM system supplied by Thermo Fisher in 2017 was £[✂]; the average price of a SEM system supplied by Thermo Fisher in 2017 was £[✂][13].

36. There are several manufacturers of EMs globally. These manufacturers can be split between those who produce TEMs and those who produce only SEMs. More detail on the differences between SEMs and TEMs is discussed below in relation to the product frame of reference.

37. The largest manufacturers of SEMs are Thermo Fisher, JEOL, Hitachi, Zeiss and Tescan. Table 1 presents estimated shares of supply of SEMs worldwide for 2017.

[12] Cryo-electron microscopy was the subject of the Nobel prize for chemistry in 2017, which was awarded to Jacques Dubochet, Joachim Frank and Richard Henderson for "*developing cryo-electron microscopy for the high-resolution structure determination of biomolecules in solution*"
https://www.nobelprize.org/prizes/chemistry/2017/press-release/
[13] Annex 4 to the Parties' response to RFI 2.

Table 1: Shares of supply for SEMs (worldwide, 2017)

SEM manufacturer	Sales (GBP 000s)	Share (%)
Thermo Fisher	[✂]	[10-20]
JEOL	[✂]	[20-30]
Hitachi	[✂]	[20-30]
Zeiss	[✂]	[20-30]
Tescan	[✂]	[5-10]
Others	[✂]	[10-20]
Total	**[✂]**	**100**

Source: Annex 1 to the Parties' response to CMA RFI, dated 21 September 2018.

38. The largest manufacturers of TEMs are Thermo Fisher, JEOL, Hitachi and Nion. Table 2 presents estimated shares of supply of TEMs worldwide for 2017.

Table 2: Shares of supply for TEMs (worldwide, 2017)

SEM manufacturer	Sales (GBP 000s)	Share (%)
Thermo Fisher	[✂]	[60-70]
JEOL	[✂]	[20-30]
Hitachi	[✂]	[5-10]
Nion	[✂]	[0-5]
Others	[✂]	[0-5]
Total	**[✂]**	**100**

Source: Annex 1 to the Parties' response to CMA RFI, dated 21 September 2018.

39. When procuring an EM, customers may require various additional peripherals to be added to the EM system to enhance its performance. These peripherals include[14]:

(a) Cameras: Cameras are used to render an image from the electrons/photons striking a sensor. There are different types of camera which can be used with an EM, dependent on the precise application and the type of specimen used. These different types include DD cameras and GI cameras. A DD camera is used to capture an image where only a low dose of electrons can be applied and therefore tends to be used only in relation to certain very specific life science applications where the sample being analysed is delicate and can only be subject to a low dose of electrons without being destroyed. In contrast, a GI camera has a much

[14] Certain of the peripherals may only be used with a TEM and others may only be used with a SEM. For example, filters, DD cameras and GI cameras are only used with TEMs.

wider application and is used for a range of purposes including system configuration and image capture.

(b) Filters: Energy filters and Electron Energy Loss Spectrometers are used alongside standalone cameras to (a) increase the quality of the image by filtering "out of focus" electrons and boosting the signal-to-noise ratio; and (b) analyse the sample by capturing or producing an image showing the presence of specific chemical species or elements.

(c) Detectors: In most cases, detectors are used to detect the presence of electrons but they can also be used to convert electrons into photons for imaging. There are a variety of detectors, including BF/DF Detectors and CL Detectors, both produced by the Target.

(d) Sample holders: The sample or specimen holder contains the specimen that is to be analysed. In some instances, the specimen holder can be used to manipulate the specimen, eg by heating it.

(e) Specimen preparation products: Specimen preparation products prepare the specimen for analysis. This category includes 3D ultramicrotomes, which are a form of specimen preparation product, which is used to slice samples to create 3D models.

40. When an end-user buys an EM with one or more peripheral, the customer will typically procure the whole system directly from the EM manufacturer. The EM supplier will either supply its own peripheral (eg Thermo Fisher produces both DD and GI cameras) or will procure it from a peripheral manufacturer such as the Target. This decision will be based on the customer's requirements, as set out in the ITT[15]. As EMs and their peripherals can require maintenance, service and support provisions are built into the arrangements with suppliers. Should a peripheral need replacing during the lifetime of an EM (ie the aftermarket), the customer will typically seek to procure it directly from the peripheral manufacturer.

Frame of reference

41. Market definition provides a framework for assessing the competitive effects of a merger and involves an element of judgement. The boundaries of the market do not determine the outcome of the analysis of the competitive effects of the merger, as it is recognised that there can be constraints on

[15] Some third parties said that, where suppliers are not vertically integrated, there can be difficulties in apportioning responsibility between the EM manufacturer and the peripheral manufacturer.

merging parties from outside the relevant market, segmentation within the relevant market, or other ways in which some constraints are more important than others. The CMA will take these factors into account in its competitive assessment[16].

42. The Parties submitted that they overlap in the supply of specimen preparation products for EMs to third party customers in the UK. The Target produces a variety of products intended to prepare a specimen for analysis (eg polishing and thinning products, contamination removal products, freezing products and cutting products), generating revenues of £[✂] in 2017. Thermo Fisher also produces specimen preparation products but with more limited revenues (£[✂]).

43. The CMA believes that the Parties also overlap in the supply of other peripherals (eg cameras and detectors). The Target produces peripherals for supply to EM manufacturers and Thermo Fisher produces these peripherals for use with its own EMs. Although Thermo Fisher does not sell these products to other EM manufacturers, it does supply them with its own EMs and to customers who already have a Thermo Fisher EM.

44. The activities of the Parties are also vertically related as the Target is active upstream in the supply of peripherals to EM manufacturers and Thermo Fisher is active downstream in the supply of EMs with peripherals. The Target supplies Thermo Fisher with cameras, filters and sample holders on a regular basis. On some rare occasions, Thermo Fisher also buys specimen preparation products and detectors from the Target.

Product scope

45. The Parties have submitted that it would be appropriate to assess the Merger by reference to:

    (a) The supply of cameras for EMs;

    (b) The supply of filters for EMs;

    (c) The supply of detectors for EMs;

    (d) The supply of sample holders for EMs;

    (e) The supply of specimen preparation products for EMs; and

[16] *Merger Assessment Guidelines*, paragraph 5.2.2.

(f) The supply of EMs[17].

46. As set out above, the Target produces detectors and sample holders for supply to EM manufacturers. However, the Parties do not overlap in the supply of sample holders and, in relation to detectors, they have a very small share of supply and there are credible alternatives available. Therefore, the CMA did not identify any plausible competition concerns in the supply of these products and they are not considered further in this decision[18].

47. The CMA discusses each of the remaining suggested product frames of reference below. The CMA has considered:

(a) The individual product components and characteristics;

(b) The Parties' submissions on supply and demand-side substitution;

(c) The Parties' internal documents;

(d) Customers' ITTs, as supplied by the Parties; and

(e) Third party evidence.

The supply of cameras to EM manufacturers

48. The Parties submitted that it would be inappropriate to segment the supply of cameras for EMs between GI cameras and DD cameras. This is because once a manufacturer is active in the supply of any type of camera, it is capable of producing or developing a range of cameras for EMs across the price/quality spectrum for use with any brand of EM. The Parties recognise however, that some manufacturers tend to specialise at one end of the spectrum.

49. However, the CMA believes that there is limited demand- and supply-side substitution between DD and GI cameras for the reasons set out below.

[17] The Parties also submitted that there is no separate independent market for the software for EMs.
[18] In relation to detectors, the Target's share of supply of BF/DF detectors for use on non-Thermo Fisher EMs is [0-10]%, and in relation to cathodoluminesence detectors it is [30-40]%. The following competitors also supply detectors: JEOL, Hitachi, Delmic, Horiba and Attolight. The Target's worldwide share of supply of sample holders for use on non-Thermo Fisher EMs is [10-20]%. The following competitors also supply sample holders: Protochips, DENSolutions, Hummingbird, Hysitron/Bruker and Fischione, as well as other EM manufacturers. The CMA has not received any concerns from third parties regarding the effects of the Merger on the supply of these products.

Demand-side substitution

50. There are significant differences in the characteristics of DD and GI cameras for use with EMs. A GI camera is used for a range of purposes including system configuration and image capture. In contrast, a DD camera tends to be used only in certain very specific life science applications. In these applications, the sample being analysed may be delicate and can only be subjected to a low dose of electrons from the EM without destroying the sample. A DD camera is used to capture an image in these circumstances, while a GI camera would be ineffective.

51. Evidence from tender documents supports this distinction, indicating that customers have very specific requirements which they set out in their ITT. These requirements depend on the precise application of the product and typically specify either a GI or DD camera.

52. The CMA also notes that DD cameras are substantially more expensive than GI cameras[19] and, therefore, are unlikely to be used unless their unique functionality is necessary. For those customers for whom the unique functionality of a DD camera is necessary, GI cameras are not a realistic alternative.

Supply-side substitution

53. The competitor set for the supply of GI cameras and DD cameras is different, with few parties supplying both products. JEOL, AMT, TVIPS and EMSIS all produce a GI camera, but do not produce a DD camera. Aside from the Parties, only Direct Electron produces a DD camera.

54. Third parties told the CMA that DD cameras are highly complex products, even for a company that already has the technical know-how to develop and supply GI cameras. For example, one third party said that "*the technical hurdle of developing the DD cameras (especially with respect to special sensors therefor (sic)) is very high*". It indicated that it would take "*at least 5 to 10 years*" for a manufacturer of GI cameras to enter the market for DD cameras[20]. Another third party suggested that it would take between 4 and 6 years to enter the market for DD cameras, even when it already supplied GI cameras, which again demonstrates the complexity of DD cameras in comparison to GI cameras.

[19] In 2016 and 2017, the Target's GI cameras sold for on average £[✂] and £[✂], respectively, and its DD cameras for on average £[✂] and £[✂].
[20] Entry is discussed further in the section on barriers to entry and expansion.

55. This evidence indicates that suppliers of GI cameras would not be able quickly to start supplying DD cameras.

56. On the basis of limited demand-side and supply-side substitutability, the CMA believes it appropriate to consider the supply of GI cameras and the supply of DD cameras in separate frames of reference.

The supply of specimen preparation products to EM manufacturers

57. The Parties submitted that all specimen preparation products constitute a single frame of reference on the basis that there is significant supply-side substitutability, evidenced by the fact that most suppliers of specimen preparation products produce a range of these products[21].

58. The Parties submitted that 3D ultramicrotomes are a form of specimen preparation product used to slice samples to create 3D models of biological samples. The Parties said that 3D ultramicrotomes is not a relevant product frame of reference because there are a range of other products and techniques used to perform the same function. For example, the focussed ion beam slice and view (manufactured by JEOL, Hitachi, Tescan), and the upcoming multibeam solution from Delft[22].

59. The CMA understands that 3D ultramicrotomes allow for automated sectioning of specimens and image capture and are typically used with SEMs. The purpose of these machines is to collect serial images from an embedded sample unattended. The result produces a stack of aligned images which can be reviewed in sequence or further processed using specialist software.

60. Third parties confirmed that a 3D ultramicrotome is very different from an ultramicrotome or a microtome as, for example, the slicing component is much smaller and sits in the column of the EM, and is able to provide 3D images. They told the CMA that the Target is the only supplier of 3D ultramicrotomes. One said that the Target's 3view, in-situ, 3D ultramicrotome and backscatter electron detector product serves a significant and growing application[23], which is only addressable with this technical solution.

61. On the basis of this evidence, the CMA believes it appropriate to assess the Merger by reference to the supply of 3D ultramicrotomes separately from other specimen preparation products.

---

[21] Paragraph 13.18 of the Parties' Merger Notice.
[22] Parties' response to RFI, dated 21 November 2018.
[23] High-resolution, large-area 3-dimensional imaging of biological and medical samples.

The supply of filters to EM manufacturers

62. The Parties submitted that the product frame of reference for filters for use with EMs should not be further segmented as, although filters come in a range of different designs and compositions, all seek to achieve the same function[24].

63. The Parties said that, from a supply-side perspective, the know-how and technology needed to produce different types of filters is similar, such that suppliers of one type of filter would be able to switch into producing or developing an alternative type of filter[25].

64. The CMA understands that there are differences in the characteristics of a post-column filter and an in-column filter. One third party told the CMA that a post-column filter (the type supplied by the Target) is capable of handling a wide energy range for a one-shot measurement, while the in-column type (provided by JEOL) has a narrow range and requires multiple measurements. Multiple measurements (as required by the in-column filter) creates a risk of potential damage to the sample caused by multiple electron beam scans.

65. The Parties said that there is nothing to suggest that JEOL's in-column filter is not an appropriate substitute for the Target's post-column filter. The Parties submitted that, in Thermo Fisher's view, the in-column filter provides a superior technical performance.

66. The CMA notes the mixed evidence but has not had to conclude on this frame of reference because, as set out below, competition concerns arise on any basis.

The supply of EMs

67. The Parties submitted that it would not be appropriate to segment the supply of EMs into the different types of EM as there is significant demand- and supply-side substitution between types of EM. The Parties said that "*whilst there will be a clear EM type that will fit the needs of some customers, the needs of other customers may fall at the boundaries of the ranges and so these customers may choose to buy different types of EMs weighing up the price of the product against the features and benefits they would receive*"[26].

68. The Parties also said that EM manufacturers can easily expand from producing one type of EM to another. The Parties gave the example of

---

[24] Parties' Merger Notice, paragraph 13.12.
[25] Parties' Merger Notice, paragraph 13.13.
[26] Parties' Merger Notice, paragraph 13.7 and Parties response to RFI 2, question 3(b).

Tescan, which they submitted is currently only supplying more basic SEMs but is in the process of developing a basic TEM. The Parties said that "*there are no insurmountable impediments to Tescan or others beginning to produce more sophisticated TEMs*"[27].

69. The following sections first discuss, with respect to demand-side and supply-side substitution, whether SEMs are a constraint on TEMs such that they should be included in the same product frame of reference, and then discuss possible segmentations within the TEMs and SEMs markets.

Demand-side substitution

70. The CMA understands that there are significant differences between TEMs and SEMs, and therefore believes that there is limited demand-side substitution, for the reasons set out below:

(a) TEMs are a type of electron microscope that has three essential systems: (i) an electron gun, which produces the electron beam, and the condenser system, which focuses the beam onto the object; (ii) the image-producing system, consisting of the objective lens, movable specimen stage, and intermediate and projector lenses, which focus the electrons passing through the specimen to form a real, highly magnified image; and (iii) the image-recording system, which converts the electron image into some form perceptible to the human eye. In addition, a vacuum system, consisting of pumps and associated gauges and valves, and power supplies are required.

(b) SEMs are a type of EM which uses a beam of focused electrons of relatively low energy as an electron probe, which is scanned over the specimen. The action of the electron beam stimulates the emission of high-energy backscattered electrons and low-energy secondary electrons from the surface of the specimen.

71. The CMA understands that these different characteristics are reflected in the different uses of TEMs and SEMs. TEMs are more powerful than SEMs (they can be used to see objects just 1 nanometre in size) and can produce images that have a higher magnification and greater resolution than SEMs. Third parties consistently said that TEMs and SEMs cannot be used interchangeably.

[27] Parties' response to RFI 2, question 3(b).

72. The Parties also told the CMA that certain peripherals are only used with TEMs (eg filters, DD cameras and GI cameras).

73. In addition, the Parties provided the CMA with a large number of ITTs published by end-users in recent years. In all cases, these ITTs specified whether the product being procured was a SEM or a TEM, indicating their different uses.

74. These differences between TEMs and SEMs were also corroborated by the Parties' internal documents. For example, the Market Transmission Electron Global 2017 report[28], stated that the threat of substitutes to TEMs is only moderate, as "*TEMs are fundamentally advanced when compared to other microscopes. So, they do not have a threat of substitutes. However, hybrid electron microscopes can pose a challenge*."

75. The CMA also noted that the prices charged for TEMs tend to vastly exceed those charged for SEMs. In 2017, the average price of a Thermo Fisher TEM system was £[✂], while the average price of a Thermo Fisher SEM system was £[✂][29].

Supply-side substitution

76. The CMA found that certain competitors are active only in SEMs (eg Zeiss and Tescan) while others are only active in TEMs (ie Nion). As set out in Tables 1 and 2 above, the Parties' shares of supply vary significantly between the supply of TEMs and SEMs[30].

77. A third party told the CMA that there would be significant technical barriers for SEMs manufacturers to expand into TEMs, and the Parties provided no recent examples of a supplier of SEMs yet successfully supply TEMs[31].

78. This evidence indicates that suppliers of SEMs are not able to quickly start supplying TEMs.

79. Therefore, on the basis of limited demand-side and supply-side substitutability, the CMA believes that it is appropriate to assess the Merger by reference to the supply of SEMs and the supply of TEMs separately.

---

[28] Attachment D24 to the Merger Notice.
[29] Annex 4 to the Parties' response to RFI 2.
[30] The share of supply of Thermo Fisher in 2017 at a worldwide level was [60-70]% in the supply of TEMs and [10-20]% in the supply of SEMs.
[31] As stated above, the Parties have submitted that Tescan, currently a supplier of SEMs, is in the process of developing a TEM.

Segmentation within TEMs and SEMs

80. Both the Parties and third parties indicated that there is a wide range of TEMs and SEMs, in terms of quality, design, functionality and price. For example, the TEMs sold by the Parties in the UK in 2016 and 2017 ranged from £[✂] to £[✂] (for the system, including peripherals)[32]. Therefore, the CMA considered whether these frames of reference should be narrowed further.

81. As discussed above, from a demand side, each end-user has different needs, and receives an individually tailored product and price. The CMA found that, for the EM itself, there is no clear point which delineates a basic TEM or SEM from a more sophisticated TEM or SEM. Moreover, although suppliers of EMs typically focus more on either basic or sophisticated needs, there is some cross-over in supply (as indicated in the wide price bracket for Thermo Fisher's TEMs in 2016 and 2017). For this reason, the CMA has not distinguished separate frames of reference for TEMs or SEMs by quality, price bracket, primary function or customer type. However, it has considered the closeness of competition between the Parties and the credibility of alternatives by these factors in its competitive assessment.

82. In addition, the CMA noted that end-customers typically purchase an EM with one or more peripheral, depending on their needs, and found that the competitive conditions for the supply of TEMs and SEMs vary depending on which peripherals are included. For example, if the end-user requires a TEM with a filter, a DD camera or a GI camera, TEM manufacturers can only compete if they have access to the relevant peripheral, either manufactured in-house or acquired from a peripheral manufacturer such as the Target, at a competitive price.

83. Therefore, the CMA has defined separate frames of reference for TEMs and SEMs in combination with each peripheral, ie: (i) TEMs with filters; (ii) TEMs with DD cameras; (iii) TEMs with GI cameras; (iv) TEMs with other specimen preparation products; (v) SEMs with 3D ultramicrotomes; and (vi) SEMs with other specimen preparation products. The CMA notes that there is some overlap in these product frames of reference as some of the Parties' sales will fall into more than one frame of reference, ie where a TEM is sold with multiple peripherals.

[32] Annex 1 to the Parties' response to the RFI dated 5 September 2018 (**RFI 1**), as updated in response to RFI2. The range stated is the range for EMs sold with a camera.

Conclusion on product scope

84. For the reasons set out above, the CMA has assessed the impact of the Merger in the following product frames of reference:

(a) Upstream, the supply of the following products to EM manufacturers:

(i) Filters;

(ii) DD cameras;

(iii) GI cameras;

(iv) 3D ultramicrotomes; and

(v) Other specimen preparation products.

(b) Downstream, the supply of the following products:

(i) TEMs with filters;

(ii) TEMs with DD cameras;

(iii) TEMs with GI cameras;

(iv) TEMs with other specimen preparation products;

(v) SEMs with 3D ultramicrotomes; and

(vi) SEMs with other specimen preparation products.

Geographic scope

85. The Parties submitted that the relevant geographic scope is worldwide for the following reasons:

(a) The major competitors are all active globally;

(b) The major competitors supply globally from a small number of sites, for example, the Target produces its EM peripherals in [✂] and [✂] and ships them globally;

(c) There are no regulatory or other barriers which prevent cross-border sales; and

(d) Transport costs are not material (between [0-10]%) relative to the total value of an EM system.

86. The CMA found that the Parties and all their main competitors supply customers all over the world. For example, JEOL and Hitachi (both EM producers) are based in Japan; Zeiss and Tescan (both producers of SEMs) are based in Europe (Germany and the Czech Republic, respectively); and Direct Electron (a producer of DD and GI cameras) is based in the US. Third parties also confirmed that there are no significant geographic barriers.

Conclusion on geographic scope

87. For the reasons set out above, the CMA has assessed the impact of the Merger using worldwide geographic frames of reference.

Conclusion on frame of reference

88. For the reasons set out above, the CMA has assessed the impact of the Merger in the product frames of reference identified in paragraph 84 at a worldwide level.

Competitive assessment

89. The CMA has assessed the following theories of harm:

    (a) Vertical effects arising through input foreclosure of competing EM manufacturers; and

    (b) Horizontal effects arising from the loss of competition in the supply of DD cameras.

90. The CMA's analysis of each of these theories of harm is set out below.

Vertical effects

91. Vertical effects may arise when a merger involves firms at different levels of the supply chain, for example a merger between an upstream supplier and a downstream customer or a downstream competitor of the supplier's customers.

92. Vertical mergers may be competitively benign or even efficiency-enhancing, but in certain circumstances can weaken rivalry, for example when they result in foreclosure of the merged firm's competitors. The CMA only regards such foreclosure to be anticompetitive where it results in an SLC in the foreclosed

market(s), not merely where it disadvantages one or more competitors[33]. In the present case, the CMA has considered whether the Merged Entity could engage in input foreclosure in relation to the supply of the Target's filters, DD cameras, GI cameras and 3D ultramicrotomes to rival EM manufacturers.

93. The CMA's approach to assessing vertical theories of harm is to analyse (a) the ability of the merged entity to foreclose competitors, (b) its incentive to do so, and (c) the overall effect of the strategy on competition[34]. In practice, the analysis of these questions may overlap, and many factors may affect more than one question.

94. The CMA considered the Merged Entity's ability to foreclose rivals in relation to the supply of other specimen preparation products (ie not 3D ultramicrotomes) for use with SEMs and TEMs. The CMA found that there are numerous credible alternative suppliers and low incentives for the Parties to foreclose competitors' access to this product. For these reasons, the CMA did not identify any vertical competition concerns arising from the Merger in relation to other specimen preparation products and these products are not considered further in this decision.

Methods of foreclosure

95. The CMA has assessed whether the Merged Entity will have the ability and incentive to engage in any total or partial foreclosure strategies in relation to the supply of the following peripherals of the Target to the Merged Entity's rivals downstream: filters, DD cameras, GI cameras and 3D ultramicrotomes.

96. Total input foreclosure means that the Merged Entity could stop supplying its rivals downstream altogether. Partial input foreclosure means that the Merged Entity could harm its downstream rivals by, for example: (i) price increases; (ii) deterioration of the hardware product (in this case, the Target's peripherals), (iii) deterioration of relevant software; (iv) delayed or reduced access to future improvements and/or newly developed products or software; and/or (v) reduced collaboration with respect to future development affecting integration of the product.

97. The CMA has not separately assessed each possible method of foreclosure. As stated above, in this document, the term 'input foreclosure' refers to either partial or total foreclosure unless stated otherwise.

---

[33] In relation to this theory of harm 'foreclosure' means either foreclosure of a rival or to substantially competitively weaken a rival.
[34] *Merger Assessment Guidelines*, paragraph 5.6.6.

Ability to foreclose

98. In order to assess the Merged Entity's ability to foreclose rival EM manufacturers, the CMA has sought to answer the following questions in relation to filters, DD cameras, GI cameras and 3D ultramicrotomes:

    (a) Will the Merged Entity have market power upstream?

    (b) How important are the filters, DD cameras, GI cameras and 3D ultramicrotomes manufactured by the Merged Entity for suppliers of TEMs?

    (c) To what extent would the supply agreements agreed between Thermo Fisher, the Target, and JEOL and Hitachi protect these downstream rivals of Thermo Fisher in the supply of TEMs?

99. While these questions overlap in important respects, the CMA believes that they provide a useful framework for its analysis.

100. The Merged Entity's ability to foreclose also depends on the scope for entry upstream. This issue is discussed separately in the section on barriers to entry and expansion.

Market power upstream

101. The CMA has considered the extent of the Target's market power in relation to filters, DD cameras, GI cameras and 3D ultramicrotomes. As explained in relation to each product individually below, the Target is the only non-vertically integrated supplier of filters, there is only one other competitor in the supply of DD cameras (and there is some evidence that this supplier is not a close competitor to the Parties), the Target has by far the largest share in the supply of GI cameras, and a third party has told the CMA that the Target is the only supplier of 3D ultramicrotomes. Although Thermo Fisher currently only supplies DD cameras and GI cameras internally (see the section on horizontal effects below), the Merged Entity would account for a very large proportion of all cameras supplied post-Merger.

102. Some third parties also noted the importance of the Target's software packages. For example, one third party said that software is a major consideration in material science and that the Target's software is very popular for the analysis of images. Another end-user said that its main concern arising from the Merger was that Thermo Fisher would gain control over the Target's software that is used to operate its detectors. The CMA understands that the Target's software package is very widely used by end-customers, and that it is very important to the successful operation of the EM

and its peripherals. This may further underpin the Target's market power upstream, to the extent that competing peripherals are not able to interact as well with the Target's software.

103. The Parties submitted that, for all three products, there are alternative sources of supply available[35]. The Parties also said that competing TEM suppliers can self-supply or sponsor new entry[36].

- *Filters*

104. The Target is currently the only non-vertically integrated supplier of filters globally, and the only manufacturer of post-column filters. JEOL manufactures an in-column energy filter, but does not supply these to other EM manufacturers.

105. The Parties submitted[37] that there is nothing to suggest that JEOL's in-column filter is not an appropriate substitute for the Target's post-column filter. In Thermo Fisher's view, an in-column filter provides a superior technical performance. The Parties said that there have been a number of instances where a JEOL filter had been supplied for use in life sciences (including to the University of Glasgow and KCL). The Parties also noted that CEOS is a new entrant which will soon be supplying filters (see below in relation to entry and expansion).

106. In contrast, a third party told the CMA that the JEOL in-column filter is not a close substitute for the Target's post-column filter because the post-column filter is capable of handling a wide energy range for a one-shot measurement while the in-column filter has a narrow range that requires multiple measurements. The third party said that the fact that many end-customers of JEOL's TEMs (which incorporate JEOL's in-column filter) also acquire the Target's post-column filter indicates that the two types of filter are not readily substitutable.

107. The CMA notes that, even if it were to consider JEOL's in-column filter a substitute for the Target's post-column filter, the Target would still have an [80-90]% share of supply in relation to all filters.

108. On the basis of this evidence, and given its findings below that it has not seen evidence of timely, likely or sufficient entry or expansion in filters, the CMA

[35] Paragraph 5.17 of the Parties' Response to the Issues Letter, 29 November 2018.
[36] Paragraph 5.19 of the Parties' Response to the Issues Letter, 29 November 2018.
[37] Paragraph 5.17(iii) of the Parties' Response to the Issues Letter, 29 November 2018.

believes that the Target has substantial market power in the supply of filters worldwide.

- *DD cameras*

109. The Target is currently one of two non-vertically integrated suppliers of DD cameras, together with Direct Electron. Thermo Fisher also manufactures DD cameras, but does not offer them for sale to other EM manufacturers. Excluding Thermo Fisher's self-supply, the Target's share of supply in DD cameras worldwide has varied between [40-50]% and [70-80]% in the last three years[38].

110. The Parties submitted that Direct Electron's DD camera is widely used for life science applications and that Direct Electron has beaten the Target in a number of tenders in recent years, including to supply the Medical Research Council for use in the study of structural biology, and to supply the University of Göttingen, which is a world leader in multi-scale bioimaging[39][40].

111. However, a third party told the CMA that the Target's camera is better in terms of electron counting than Direct Electron's camera, which makes it more suitable for some applications. The third party also said that the Direct Electron DD camera cannot sit behind the Target's filter and that it had been Direct Electron's strategy to differentiate its products from the Target's, by tailoring its products to material science applications rather than life science applications (where the Target's DD cameras are typically used). For these reasons, the CMA believes that Direct Electron is not a close competitor to the Target in relation to the supply of DD cameras.

112. Another third party noted that many customers, when buying a TEM, will require both a DD camera and a filter. The Parties told the CMA that "*only the Gatan DD camera is technically compatible to work as part of the Gatan filter*"[41]. Indeed, the Target only supplies its camera and filter together in one package. Customers consistently told the CMA that, given the Target's unique position across both these products, in particular in relation to filters, it faces little, if any, competition. One life science end-user told the CMA that the Target's DD camera with the energy filter is simply the best solution available.

---

[38] Annex 1 to the Parties' response to CMA RFI2. When self-supply is included the Target's share is between [20-60]% worldwide and the combined share of the Parties post-Merger would be between [70-90]% worldwide.
[39] Paragraph 5.17(ii) of the Parties' Response to the Issues Letter, 29 November 2018.
[40] The CMA notes that two of the three tenders won by Direct Electron in the UK refer to the sale of DD cameras on a standalone basis and not of a DD camera together with a TEM, which suggest that Direct Electron's cameras were purchased to complement other cameras that the customer already had.
[41] Paragraph 10.5(i) of the Parties' Response to the Issues Letter, 29 November 2018.

113. For life science applications, all the Target filters are sold with a Target DD camera integrated into the filter. As these products are sold in combination, the importance of Target's filters for TEM manufacturers – in which the Target is the sole non-vertically integrated supplier – enhances even further the market position of the Target in DD cameras.

114. On the basis of this evidence, and given its findings below that it has not seen evidence of timely, likely or sufficient entry or expansion in DD cameras, the CMA believes that the Target has substantial market power in relation to DD cameras, particularly when those cameras are combined with a filter.

- *GI cameras*

115. The Target is currently one of five global non-vertically integrated suppliers of GI cameras. However, it is by far the largest, with a share of supply of GI cameras worldwide varying between [50-60]% and [60-70]% in recent years (excluding self-supply)[42]. Thermo Fisher and JEOL also manufacture GI cameras but only for self-supply with their TEMs[43].

116. The Parties submitted that AMT, TVIPS and EMSIS all sell high-quality GI cameras and, in recent years, have won tenders in which the Target has also bid. In addition, in collaboration with JEOL, Hamamatsu has modified one of its visible light cameras into a GI camera for use with a TEM, and JEOL now offers this new camera (Matataki Flash) for use with its TEMs[44].

117. However, a third party told the CMA that the Target's filters work better with the Target's cameras than with competing cameras, which gives the Target a particular competitive advantage in the supply of GI cameras, as customers often require them with a filter[45]. The CMA has also heard that the Target's GI cameras are higher-specification than most of their competitors. A third party said that the Target's GI cameras are more suitable for use with a TEM, whereas the competing GI cameras (excluding Thermo Fisher's and JEOL's self-supply) are more often used with a SEM.

118. For material science applications, all the Target's filters are sold with a Target GI camera integrated into the filter. As these products are sold in combination,

---

[42] Annex 1 to the Parties' response to CMA RFI2.
[43] When self-supply is included, the Target's share is between [30-40] and [40-50]% worldwide, and the combined share of the Parties post-Merger would be between [60-70] and [70-80]%.
[44] Paragraph 5.17(i) of the Parties' Response to the Issues Letter, 29 November 2018.
[45] The CMA notes that in 2016 and 2017, [50-60]% of the TEMs with a camera that Thermo Fisher sold in the UK also came with a filter (Annex 1 to the Parties' response to the RFI, dated 5 September 2018, as updated in response to RFI2).

the importance of Target's filters for TEM manufacturers enhances even further the market position of the Target in GI cameras.

119. On the basis of this evidence, the CMA believes that other non-vertically integrated suppliers of GI cameras impose only a limited competitive constraint on the Target in the supply of GI cameras. Therefore, and given its findings below that it has not seen evidence of timely, likely or sufficient entry or expansion in GI cameras, the CMA believes that the Target has substantial market power in relation to GI cameras, particularly when those cameras are combined with a filter. However, the CMA recognises that the Target's market power in relation to GI cameras is weaker than in relation to filters or DD cameras.

- *3D ultramicrotome*

120. The Parties submitted that:

(a) There are several third-party suppliers of competing microtome products, including Eden, RMC Boeckleler, and Leica;

(b) There are other competing techniques, including focussed ion beam slice and view (eg from JEOL, Hitachi and Tescan), and the upcoming multibeam solution (from Delft); and

(c) Barriers to entry are low since the technology is simple and not protected by IP.

121. However, one third party told the CMA that the Target is the only supplier of "*an in-situ ultramicrotome with 3view, including a specialized backscattered electron detector and software*". One third party said that Thermo Fisher's volume-scope is the only possible alternative to this product, though another third party did not identify the Thermo Fisher product as an alternative, saying that it does not have the same quality and cannot be used for the same applications.

122. On the basis of this evidence, the CMA cannot rule out that the Target has substantial market power in relation to 3D ultramicrotomes. Therefore, given the mixed evidence, it continued to assess the other factors relevant to assessing ability for input foreclosure.

Importance of the Target's filters, DD cameras GI cameras and 3D ultramicrotomes to suppliers of TEMs and SEMs

- *Third party evidence*

123. Several customers told the CMA about instances where they had either specifically asked for the Target's filter, DD camera, GI camera or 3D ultramicrotome to go with a TEM, or where only the Target's peripheral was able to meet their demands as specified in the ITT. Customers said that, in these circumstances, only a TEM supplier which had access to the Target's peripheral on competitive terms would have been considered a credible bidder. Customers generally noted that EM manufacturers had always outsourced their supply of filters to the Target and DD cameras to either the Target or Direct Electron.

124. One EM manufacturer expressed concerns with the Merger, in particular in relation to its ability to continue collaborative development with the Target given that post-Merger it will be part of a rival EM manufacturer. Another third party noted that for another EM manufacturer to start supplying TEMs, gaining access to the Target's DD cameras and filters would be a key requirement as these peripherals were critical to the success of a TEM.

125. In general, third parties (both end-users and other EM manufacturers) were highly concerned about whether, post-Merger, the Target would continue to supply other EM suppliers with its peripherals, and on the same terms and with access to all future developments suited to their needs[46].

- *Internal documents*

126. The views of third parties are consistent with statements in the Parties' internal documents, which recognise the importance of the Target's filters, DD cameras, GI cameras and 3D ultramicrotomes to EM manufacturers. The Parties' documents also indicate that the importance of certain peripherals to end-users and other EM manufacturers was a factor in Thermo Fisher's rationale for the Merger. For example:

[46] The CMA notes that it is not clear to what extent end-users and other EM manufacturers were aware of the existence of the supply agreements with JEOL and Hitachi (as discussed further below), though Thermo Fisher has made a public commitment on its website to continue to supply Target products to third parties and the CMA understands that it has made the same commitment in letters to its EM customers.

(a) Thermo Fisher's Inorganic Growth Board document describes how the Merger [✂][47];

(b) The Project Pasteur Discussion Materials from 8 March 2018 comment on the Parties' ability post-Merger to [✂][48];

(c) The Gatan Annual Review from November 2017, where the Target assesses its relationship with JEOL, and describes the importance of the Target's products to JEOL as [✂][49];

(d) The Project Pasteur Management Meeting notes from 13 February 2018, where the Target's camera and filter technology is described as [✂], with the Parties commenting that they [✂][50]; and

(e) The Global Transmission Electron Microscope Market Report from 2017-2021 which notes that the bargaining power of suppliers of peripherals to TEM manufacturers is high: "*Though there are many suppliers to TEM, they all have unique product offerings. If the suppliers stop manufacturing the unit parts, it can highly impact the TEM production. A delay in supply can sometimes cause a revenue loss to the end manufacturers*"[51].

- *Foreclosure of potential new entrants to the supply of EMs*

127. The CMA also considered whether the Merged Entity would have the ability to foreclose new suppliers of EMs (ie increasing barriers to entry in the supply of EMs by limiting access to its peripherals).

128. The Parties submitted that the Merged Entity could not harm competition by foreclosing a new downstream entrant for the following reasons[52]:

(a) There is no evidence of any new entrant needing the Target's peripherals to enter the TEMs market. Tescan appears to be planning to enter the supply of TEMs without the Target's peripherals.

(b) A new entrant (like Tescan) could use alternative sources of supply, such as existing alternative suppliers of peripherals, self-supply by developing its own peripherals, or by sponsoring the entry of a peripherals producer.

---

[47] Attachment D2 to the Parties' Merger Notice.
[48] Attachment D9 to the Parties' Merger Notice.
[49] Attachment 37 to the Parties' response to RFI, dated 11 October 2018 (**RFI 3**).
[50] Attachment D11 to the Merger Notice.
[51] Attachment D24 to the Merger Notice.
[52] Paragraph 1.4 ad 7.2 of the Parties' Response to the Issues Letter, 29 November 2018.

(c) There is no basis on which to distinguish an entrant who needs the Target's peripherals compared with a customer which is seeking to buy them but has other options (and so could not be foreclosed through refusing to supply). This means that all customers benefit from competitive supply.

(d) Since JEOL and Hitachi cannot be foreclosed (due to the supply agreements (see below)), there would be no incentive for Thermo Fisher to foreclose a new entrant as it would mean foregoing peripheral revenue with no guarantee of increased TEM sales (since JEOL and Hitachi could be the beneficiaries of any recaptured sales).

129. However, for the reasons set out above, the CMA has found that the Target's peripherals are often key in a customer's decision to purchase an EM. In many cases, new entrants would not have outside options, as is the case with existing EM providers. Moreover, as set out below, the CMA does not believe that it can rely on the supply agreements to ensure that JEOL and Hitachi are not foreclosed. For these reasons, the CMA believes that the Merged Entity would have a similar ability to foreclose new entrants from its peripherals as it would incumbent providers.

Supply agreements

130. As explained above, since announcing the Merger, the Parties have entered into long-term agreements for the supply of the Target's peripherals for use with EMs with their two main rivals in the supply of TEMs (JEOL and Hitachi). The Parties have submitted that these agreements are in its commercial interests. However, the CMA also understands that the agreements have been prepared mindful of competition authority scrutiny and are conditional on completion of the Merger.

131. The Parties signed the Memorandum of Understanding with JEOL on [✂] and the master supply agreement with Hitachi effective from [✂] (together referred to as **the supply agreements**). These long-term supply agreements will come into effect on completion of the Merger[53].

132. The Parties submitted that the rationale behind the negotiation of these agreements is to safeguard the future position of JEOL and Hitachi, the only two existing competitors who could potentially be foreclosed by the Merged Entity (with JEOL making up around [75-100]% of third party purchases of Target cameras and filters, and Hitachi making up [✂])[54]. The Parties also

[53] The CMA notes that, in relation to the [✂].
[54] Paragraph 5.1 of the Parties' Response to the Issues Letter, 29 November 2018.

submitted that the supply agreements are legally binding and enforceable and will therefore address any plausible vertical concerns of the CMA.

133. As stated above, the CMA has excluded the supply agreements from its counterfactual (see paragraph 31). However, it has considered whether, and if so to what extent, the supply agreements could limit the Merged Entity's ability to engage in an input foreclosure strategy.

134. The CMA believes that certain aspects of the supply agreements raise significant doubts [✂].

(a) [✂]

(b) [✂][55]

(c) [✂].

(d) [✂][56]/[57]

135. The CMA also notes that the supply agreements only apply to the Parties' existing customers in TEMs (ie JEOL and Hitachi). They do not impact the Parties' ability to foreclose other existing or potential competitors in the downstream market. The Parties submitted that the Merged Entity could not harm competition by foreclosing a new downstream entrant for the reasons set out in the incentive section below (see paragraph 139 onwards).

136. It is not the CMA's practice to exclude the possibility of vertical effects arising on the basis of agreements entered into by the merging parties in the context of the merger. These types of agreements rely on behavioural obligations from the merging parties which are, by their nature, difficult to monitor and enforce and, given the variety of mechanisms that the merging parties can use to foreclose rivals, it is difficult for such agreements to effectively exclude all possibilities.

137. On the basis of this evidence, the CMA believes that the supply agreements may limit the Merged Entity's ability to totally foreclose JEOL and Hitachi, but they do not sufficiently mitigate or eliminate the ability of the Merged Entity to foreclose its rivals downstream, in particular in relation to pipeline products and products as yet unidentified.

---

[55] [✂].
[56] The Parties have submitted that [✂] (Parties' Response to the Issues Letter, 29 November 2018).
[57]The Merger Remedies Guidance states in paragraph 7.4 (a) that markets that are subject to frequent change in products or supply arrangements may be particularly prone to specification risk if the definition of required conduct is vulnerable to such changes.

Conclusion on ability

138. For the reasons set out above, the CMA believes that, post-Merger, the Merged Entity may have the ability to foreclose competing EM manufacturers in relation to filters, DD cameras, GI cameras and 3D ultramicrotomes.

Incentive to foreclose

139. The Merged Entity's incentive to foreclose depends on the loss of profit in the peripherals market ("upstream") that would result from the foreclosure strategy, and on the associated gain in profit in the EM market ("downstream").

140. To assess the extent to which Thermo Fisher would profit by foreclosing competing EM manufacturers, the CMA considered the extent to which Thermo Fisher and its downstream rivals compete in relation to the supply of TEMs. The CMA considered the following factors: (i) Thermo Fisher's share of supply; (ii) the Parties' internal documents; and (iii) third parties' views.

141. The CMA found that Thermo Fisher has an [80-90]% share of supply in TEMs sold with filters, [70-80]% in TEMs sold with DD cameras and [60-70]% in TEMs sold with GI cameras. As set out in Tables 1 and 2 above, Thermo Fisher is [✂] in the supply of TEMs (JEOL) and both Thermo Fisher and JEOL are considerably larger than the next biggest supplier (Hitachi)[58].

142. This is supported by the Target's internal documents. For example the Target's Annual Review from November 2017 states that: [✂][59].

143. Given that Thermo Fisher would uniquely have access to the Target's peripherals, which third parties have indicated are often a necessary input (see paragraphs 123-125 above), and given Thermo Fisher's share of supply downstream, the CMA believes that Thermo Fisher is likely to capture almost all sales diverted from its competitors through a foreclosure strategy. Moreover, given its strong position downstream, the Merged Entity may have an incentive to adopt strategies that increase and preserve this position. For example, in one internal document Thermo Fisher states: [✂][60].

[58] Thermo Fisher has a [60-70]% share of supply of TEMs worldwide, while JEOL has [20-30]% and Hitachi has [0-10]%.
[59] Slide 3 of Attachment 37 to the Parties' response to RFI 3.
[60] Slide 54 of Attachment B to the Parties' Merger Notice.

144. With regard to 3D ultramicrotomes, the CMA has found that the Merged Entity is unlikely to have an incentive to foreclose its competitors, for the following reasons:

(a) The Parties have a significantly lower combined share of supply in SEMs than in TEMs, with a number of alternative SEM suppliers being credible alternatives;

(b) The Parties had sales of £[✂] globally in 3D ultramicrotomes in 2017, achieved through the sale of only [✂]; and

(c) Information provided by Thermo Fisher in relation to its gross margins in SEMs and the Target's average revenue from 3D ultramicrotomes indicated that the Merged Entity would not have an incentive to foreclose competitors post-Merger as the revenue lost due to reduced 3D ultramicrotome sales would not be recaptured by increased SEM sales.

145. For these reasons, the CMA does not believe the Merger gives rise to a realistic prospect of an SLC as a result of vertical effects arising from the foreclosure of the supply of 3D ultramicrotomes worldwide, and this product is not considered further in this decision.

Total foreclosure - Loss of profits upstream (filters, DD cameras and GI cameras)

146. In a situation of total input foreclosure, the loss of profits upstream is indicated by the gross profit earned on the filters, DD cameras and GI cameras multiplied by the reduction in volume of sales as a result of the foreclosure strategy.

147. The Parties estimated that the average gross profit earned by the Target in 2017 was: £[✂] for filters; £[✂] for DD cameras; and £[✂] for GI cameras.

148. The upstream loss of sales associated with a total input foreclosure strategy is more difficult to estimate. An outright refusal to supply would involve the loss of all peripheral sales made by the Target to the Merged Entity's downstream rivals. However, because some final customers would switch to purchasing TEMs from the Merged Entity, for which it would also supply peripherals, these upstream sales would not be lost. The overall loss of peripheral sales from a total foreclosure strategy would therefore be the proportion of TEM sales made by the Merged Entity's rivals that would not switch to Thermo Fisher.

149. The CMA asked a range of third parties to estimate the share of sales that the Merged Entity's downstream rivals would lose should the Merged Entity

deploy a total input foreclosure strategy for filters, DD cameras and GI cameras. The typical estimate was in the range of 40%-50% of TEM sales. This implies that the Merged Entity would lose at most 50%-60% of its upstream sales of peripherals.

150. These figures suggest that the cost of a total foreclosure strategy in lost profits upstream could be in the region of £[✂] per year.

Total foreclosure - Gain in profits downstream (filters, DD cameras and GI cameras)

151. In a situation of total input foreclosure, the gain in profits downstream is indicated by the gross profit earned on TEMs multiplied by the increase in sales experienced by Thermo Fisher as a result of the foreclosure strategy.

152. The Parties estimated that the average gross profit that Thermo Fisher earned on its TEMs in 2017 was £[✂]. The CMA notes that this represents a lower bound estimate of the gains that it would earn per additional EM sale following a successful input foreclosure strategy, as the increase in market power downstream resulting from foreclosure would increase its margins.

153. While the CMA has not examined worldwide data about the margins earned on the sale of TEM systems, it has analysed the data provided by the Parties regarding their sales in the UK in 2016 and 2017. This produced the following average margins according to the package supplied:

(a) When a filter was included in the package, Thermo Fisher earned an average gross profit of $[✂].

(b) When a DD camera was included in the package, Thermo Fisher earned an average gross profit of $[✂].

(c) When a GI camera was included in the package but no DD camera, Thermo Fisher earned an average gross profit of $[✂].

154. As discussed above, the margins that the Target earned on GI cameras and DD cameras were £[✂] and £[✂], respectively. Assuming that the margins Thermo Fisher earned on the GI cameras and DD cameras it self-supplied were no higher, this suggests that TEMs sold with DD cameras and/or filters typically attract a substantially higher margin than TEMs sold only with a GI camera.

155. In terms of the increase in sales of Thermo Fisher's TEMs arising from the foreclosure strategy, third parties indicated that they could lose 40-50% of their TEM sales. In light of Thermo Fisher's strong position downstream, and

the fact that it has the ability to foreclose both of its rivals, it is likely that it would gain the vast majority of these TEM sales lost by its rivals.

156. These figures suggest that the benefits of a total foreclosure strategy in terms of additional profits to Thermo Fisher could be in the region of £[✂] per year.

157. These estimates of the potential benefits of total foreclosure are substantially greater than the estimates of the potential costs (see paragraph 150). This result applies with respect to each peripheral: filters, DD cameras and GI cameras.

- *Reaction of TEM manufacturers and new entry*

158. The Parties submitted that upstream entry by new peripheral manufacturers would reduce any benefits of foreclosure to only a few years. The Parties said that higher margins downstream would mean that JEOL and Hitachi would have a strong incentive to counteract any foreclosure measure undertaken by the Merged Entity, by enforcing the supply agreements, using an alternative supplier or developing their own peripheral products[61].

159. The Parties submitted that the potential entry by JEOL, Hitachi or others in the supply of new peripherals would remove any foreclosure incentive as the Merged Entity would forego peripherals revenue in the long term for limited upside in TEM revenues in the short term. Moreover, as JEOL and/or Hitachi would become stronger competitors in TEMs than they otherwise would have been (due to integration benefits), any short-term gains would be significantly outweighed by losses in TEM sales in the medium to long-term[62]. The Parties estimated that entry within [✂] years of the start of foreclosure would completely negate any benefits of foreclosure and result in overall losses for the Merged Entity[63].

160. The CMA has found that, for filters and DD cameras, the time actually taken by third parties to enter the market (as opposed to estimates) was in excess of 3 years (see the discussion of barriers to entry and expansion below). In relation to GI cameras, the evidence was more mixed. On the basis of this evidence, the CMA does not believe that it can rely on entry being sufficiently timely to remove any incentive to foreclose[64].

---

[61] Paragraph 5.35-37 of the Parties' Response to the Issues Letter, 29 November 2018.
[62] Paragraph 6.4 of the Parties' Response to the Issues Letter, 29 November 2018.
[63] Annex 5 (Economic Analysis Paper) to the Parties' Response to the Issues Letter, 29 November 2018.
[64] When considering efficiencies, prospects for entry and expansion and countervailing buyer power, and having regard to the realistic prospect threshold, the CMA will require compelling evidence if it is to conclude on the basis of these factors that the merger should not be referred to Phase 2 (paragraph 5.1.3, Merger Assessment Guidelines).

161. Overall, on the basis of the evidence set out above, the CMA believes that the Merged Entity has the incentive to totally foreclose its rivals downstream with respect to the supply of filters, DD cameras and, to a lesser extent, GI cameras.

Partial foreclosure – Loss of profits upstream and gain of profits downstream (filters, DD cameras and GI cameras)

162. With regard to partial foreclosure, it is difficult to estimate the precise magnitude of the costs and benefits, as this will depend on which of the range of methods the Merged Entity adopted to foreclose its rivals.

163. In terms of the costs of partial foreclosure, any upstream loss of sales is likely to be limited given the substantial market power that the Target has in the upstream peripheral markets. Many customers indicated that they would not switch to alternative products in the context of a price rise as their choice of EM system is driven by their research application needs. Moreover, the fact that the Merged Entity has a wide range of foreclosure strategies available means that it has substantial strategic flexibility to mitigate the loss of profits upstream by carefully choosing the most appropriate strategy.

164. In terms of the benefits of partial foreclosure, these are likely to be substantial (though lower than under total foreclosure), given both Thermo Fisher's strong position in TEMs and the necessity of the Target's peripherals for some customers. For these reasons, the Merged Entity would be expected to capture a high proportion of diverting TEMs sales as Thermo Fisher's downstream margin is substantially higher than the Target's upstream margin. Overall, the CMA has calculated that a foreclosure strategy would be profitable if the Merged Entity gained one downstream sale for every 3.5 filter sales lost upstream, or one for every 5 DD camera sales lost upstream, or one for every 17 GI camera sales lost upstream. Given that the actual diversion is likely to be at least as high as 40%-50%, the CMA believes that partial foreclosure is also prima facie profitable.

165. As for total foreclosure, new entry in relation to the supply of filters, DD and GI cameras, including the possibility of self-supply by the current rival TEM manufacturers, is unlikely to eliminate the Merged Entity's incentive to partially foreclose its rivals downstream. Furthermore, partial foreclosure strategies are less likely to be quickly detected by the Merged Entity's rivals and are therefore less likely to trigger a timely response.

166. Therefore, for the reasons set out above, the CMA believes that the Merged Entity has the incentive to partially foreclose its rivals downstream with

respect to the supply of filters, DD cameras and, to a lesser extent, GI cameras.

Other evidence of the Merged Entity's incentives to foreclose its rivals downstream

167. The Parties submitted evidence of their negotiations with JEOL and Hitachi for the continued supply of the Target's peripherals, which began after the announcement of the Merger. The Parties submitted that these negotiations demonstrate the Parties' commitment to maintaining long term supply relationships between the Target and its two key customers.

168. The CMA acknowledges that the Parties' stated rationale for the Merger includes continuing to supply third party EM manufacturers. The Parties have submitted that Thermo Fisher accounts for only [30-40]% of the Target's total peripherals revenue and only [40-50]% of the Target's camera and filter revenues, meaning that the success of the Merger is dependent on maintaining and growing third party revenue[65]. The Parties provided internal documents which supported this position:

(a) Thermo Fisher's [✂] and the fact that [✂][66].

(b) The [✂][67].

(c) [✂][68].

169. However, the CMA is only able to put limited weight on the Parties' internal documents and the transaction rationale they describe as these documents were produced contemporaneously with the Merger and may have been prepared anticipating the that Merger would be subject to review by competition agencies[69].

170. Moreover, the CMA's analysis above clearly indicates that it would be profitable for the Merged Entity to engage in a foreclosure strategy in relation to the Target's filters, DD cameras and GI cameras.

171. The CMA also noted in the Parties' internal documents:

---

[65] Paragraph 6.6 of the Parties' Response to the Issues Letter, 29 November 2018.
[66] Attachment D18 of the Parties' Merger Notice
[67] Attachment D17 of the Parties' Merger Notice.
[68] Attachment D14 of the Parties' Merger Notice.
[69] See for example, in relation to the negotiation of the supply agreements, Email 24 at Annex 1 of the Thermo Fisher s109 response: [✂]

(a) A Target document indicating that, while the Target was indirectly competing with Thermo Fisher ([✂][70]), its relationship with JEOL and Hitachi was increasingly important [✂][71]. This suggests that the Merged Entity might have less incentive to support JEOL and Hitachi and to develop its relationship with these customers than absent the Merger.

(b) Documents highlighting the rationale of the Merger as including the ability of Thermo Fisher to [✂], demonstrating the importance of the supply of peripherals to EM manufacturers[72] and supporting the importance of supply of these peripherals to JEOL and Hitachi.

(c) [✂][73].

172. Therefore, the CMA does not believe that the negotiations between the Parties and JEOL and Hitachi, or their internal documents, provide compelling evidence, in contrast to the evidence set out above, that the Merged Entity would not have an incentive to foreclose its rivals post-Merger.

173. The Parties also submitted that any foreclosure of rival EM manufacturers in relation to the Target's filters, DD cameras and GI cameras would harm Thermo Fisher's broader business, both in relation to its reputation, which may be damaged on the basis of reneging on a public commitment to continue to supply, and because Thermo Fisher is already both a supplier and customer of both rival EM manufacturers in relation to other products[74]. [✂].

174. However, without a detailed analysis of the market power of both JEOL and Hitachi in relation to the products it supplies to Thermo Fisher, the CMA has not been able to assess the extent to which a possible retaliation of foreclosure in other products would act as a deterrent on the Parties in their foreclosure of filters, DD cameras and GI cameras. The CMA accepts that were the Parties to renege on a widely-known commitment to supply, this could result in reputational damage and trigger potential retaliation. However, as discussed above, some of the potential partial foreclosure strategies could be difficult for JEOL and Hitachi to detect. In these scenarios, reputational damage or retaliation seems unlikely.

---

[70] Slide 4 of Attachment 37 to the Parties' response to RFI 3.
[71] [✂]: Slide 37 of Attachment 37 to the Parties' response to RFI 3.
[72] Slide 6 of Attachment D16 and slide 27 of Attachment D2 to the Parties' Merger Notice.
[73] Slide 2 of Attachment 33 to the Parties' response to RFI 3.
[74] Annex 6 to and Paragraphs 6.11-12 of the Parties' Response to the Issues Letter, 29 November 2018.

Conclusion on incentive

175. For the reasons set out above, the CMA believes that, post-Merger, the Merged Entity may have an incentive to foreclose competing TEM manufacturers in relation to filters, DD cameras and GI cameras.

Effect

176. The effect of an input foreclosure strategy with respect to rival TEM manufacturers, whereby these downstream rivals would have reduced access to the most advanced cameras and filters, or access but on less attractive terms, would be to reduce over time the competitive constraint that these companies pose on the downstream TEM business of the Merged Entity.

177. The supply of TEMs is highly concentrated and, as explained above, Thermo Fisher has a significant share of supply. In the market for TEMs sold with DD cameras, there is only one competitor to Thermo Fisher. In all three frames of reference involving the supply of TEMs, Thermo Fisher is by far the biggest supplier[75]. The CMA notes that, in a concentrated market and in the presence of weak competition between suppliers, even a small lessening of competition can be substantial.

178. An input foreclosure strategy would also increase the barriers to entry in the supply of TEMs with filters, DD cameras and GI cameras (see below for further discussion of barriers to entry and expansion).

179. A reduction in the competitive constraint in the supply of TEMs that current and potential competitors impose on Thermo Fisher would lead to an increase in the price and/or a reduction in the quality and future innovation of these products (both by Thermo Fisher and its current and future competitors).

180. The CMA has received significant third-party concerns indicating that foreclosure of Thermo Fisher's rival TEM manufacturers in relation to the Target's filters, DD cameras and GI cameras would seriously prejudice these rivals' ability to compete in the supply of TEMs. Several third parties noted the dominant position of Thermo Fisher in the supply of TEMs and said that there was a general concern in the industry with the possibility of the Merged Entity limiting the access of its rivals to the Target's filters, DD cameras and GI cameras. Some third parties said that the effect of this lessening of

[75] The CMA has found that Thermo Fisher has an [80-90]% share of supply in TEMs sold with filters, [70-80]% in TEMs sold with DD cameras and [60-70]% in TEMs sold with GI cameras.

competition in the supply of TEMs downstream would be increased prices and worse services and support.

181. On the basis of this evidence, the CMA believes that, if Thermo Fisher's rivals were to be foreclosed upstream, this would significantly harm competition between TEM manufacturers downstream.

Conclusion on vertical effects

182. For the reasons set out above, the CMA believes that the Merger gives rise to a realistic prospect of an SLC as a result of vertical effects arising from foreclosure in the supply of filters, DD cameras and GI cameras to competing TEM manufacturers at a worldwide level.

Horizontal unilateral effects

183. The second theory of harm that the CMA has considered is horizontal unilateral effects arising from a loss of competition in the supply of DD cameras.

184. Horizontal unilateral effects may arise when one firm merges with a competitor that previously provided a competitive constraint, allowing the merged firm profitably to raise prices or to degrade quality on its own and without needing to coordinate with its rivals[76]. Horizontal unilateral effects are more likely when the merging parties are close competitors.

185. The CMA assessed whether it is or may be the case that the Merger may be expected to result in an SLC in relation to horizontal unilateral effects in the supply of DD cameras to TEM manufacturers and end-users worldwide.

186. The CMA also considered whether the Merger might give rise to an SLC in relation to horizontal unilateral effects in the supply of specimen preparation products to EM manufacturers worldwide. The CMA's concern in relation to the supply of DD cameras is that the loss of constraint arising from the Merger would allow the Merged Entity to increase prices, lower quality, reduce the range of its services and/or reduce innovation in DD cameras. This concern arises both in the situation where DD cameras are sold together with TEMs, and in the aftermarket where DD cameras are sold to end-users who already have a TEM.

---

[76] *Merger Assessment Guidelines*, from paragraph 5.4.1.
[77] The Parties have below [20-30]% share of supply in the supply of specimen preparation products, with a number of third parties also present, including Buhler who would continue to have a higher share of supply than the Merged Entity. Further, no third parties raised concerns about horizontal effects in the supply of specimen preparation products.

188. In order to assess this theory of harm, the CMA has considered:

(a) how the Parties compete in the supply of DD cameras;

(b) the shares of supply and the closeness of competition between the Parties; and

(c) the competitive constraints that would remain post-Merger.

How the Parties compete in the supply of DD cameras

189. The Parties submitted that they do not compete in the supply of DD cameras as Thermo Fisher does not sell DD cameras as standalone products. Thermo Fisher only sells DD cameras either together with a TEM or to customers who already have a compatible Thermo Fisher TEM[78].

190. [✂]. The Parties said that, in these circumstances, the Thermo Fisher DD camera is not a substitute as only the Target DD camera will work with the Target filter[79].

191. [✂][80].

192. The CMA notes that, given the Target's filters are sold with a camera, Thermo Fisher may compete, to some extent, with the Target's camera-filter combination (recognising that Thermo Fisher does not offer a filter).

193. In 2016, [✂] Thermo Fisher TEMs were sold with a Target filter ([✂] included an integrated DD camera and around [✂] included an integrated GI camera). In 2017, [✂] Thermo Fisher TEMs were sold with a Target filter ([✂] included an integrated DD camera and around [✂] included an integrated GI camera).

194. The CMA found that the Target sells cameras (all cameras) not only to TEM manufacturers (£[✂], in 2017), but also to distributors and directly to end-customers (£[✂], in 2017). Only £[✂] of its camera sales were to Thermo Fisher in the context of a customer purchasing a Thermo Fisher TEM, compared to £[✂] to distributors and end-users, suggesting that there is opportunity for competition between the Parties in relation to the supply of DD cameras on the aftermarket.

[78] Paragraphs 10.1-10.2 of the Parties' Response to the Issues Letter, 29 November 2018.
[79] Paragraph 10.5 of the Parties' Response on the Issues Letter, 29 November 2018.
[80] Paragraph 10.3 of the Parties' Response to the Issues Letter, 29 November 2018.

Shares of supply

195. Table 3 presents the Parties' shares in the supply of DD cameras (including self-supply).

Table 3: Share of Supply estimates (Worldwide and UK, 2017)

	Revenue (GBP 000s)	Share (%)
Thermo Fisher	[✂]	[40-50]
Target	[✂]	[20-30]
Combined	**[✂]**	**[70-80]**
Direct Electron	[✂]	[20-30]
Total	**[✂]**	**100**

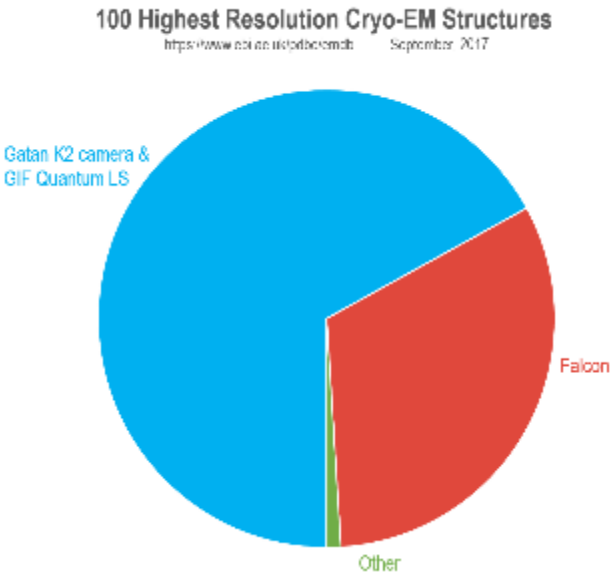
Source: Annex 1 to the Parties' response to CMA RFI, dated 21 September 2018.

Closeness of competition

196. Third parties told the CMA that, although the DD cameras supplied by the Target and Thermo Fisher are differentiated (with the Target's DD cameras being perceived as being of higher specification), they compete for some customers. Third parties told the CMA that end-users regularly request a particular brand of camera; however, for some applications, the Parties' DD cameras are each other's closest alternative.

197. For example, a pie chart on the Target's website, shows the share of supply of the Target's DD camera (Gatan K2 camera and GIF Quantum LS) and Thermo Fisher's DD camera (Falcon) in relation to the 100 highest resolution Cryo-EM structures, shown in Figure 1.

Figure 1: 100 Highest Resolution Cryo-EM Structures[81]



198. The CMA noted that, although Thermo Fisher's DD camera is provided principally with its TEM, while the Target's DD camera is often provided to rival TEM manufacturers, end-users compare the functionality of these products closely and they therefore can play a significant part in driving sales of TEMs. This indicates close competition between the manufacturers of DD cameras even if they do not often compete for direct sales (only occasionally in the aftermarket). A particular feature of this competition, alongside price, quality, range and service, is the drive to innovate.

Competition for innovation

199. The CMA considered the extent to which, as the main two developers and suppliers of DD cameras, competition to attract customers to their products (and to the TEM products with which they are sold) has driven innovation.

200. [✂][82].

201. [✂][83]:

(a) [✂]; and

(b) [✂].

---

[81] http://www.gatan.com/techniques/cryo-em
[82] Slide 4 of the Target's K3 Product Justification dated February 2017, as provided by the Parties on 3 December 2018 in response to the CMA's questions of 28 November 2018.
[83] Slides 5 and 41 to Attachment 37 of the Parties' response to RFI 3.

202. On the basis of this evidence, the CMA believes that the Parties are close competitors in the supply of DD cameras, driving lower prices, quality (in product and service) and innovation.

Competitive constraints

203. The CMA has assessed whether there would remain sufficient competitive constraints post-Merger such that the Parties would not be able profitably to increase prices, reduce quality of product or service, and/or reduce innovation.

204. Post-Merger, there will be just one competitor remaining in the supply of DD cameras for use with TEMs: Direct Electron.

205. The Parties' submitted that Direct Electron provides a high-quality DD camera for use in both life science and material science applications, and that it is more of a direct competitor to the Target than Thermo Fisher[84].

206. However, as set out above (see paragraph 111), the CMA understands that the Target's DD camera is better perceived in terms of electron counting than Direct Electron's DD camera, and that the latter cannot sit behind the Target's filter. Moreover, one third party told the CMA that Direct Electron has sought to differentiate its products from the Target's by tailoring them to material science applications. This differentiation is supported by the graph shown at Figure 1 above, taken from the Target's website.

207. The Parties also submitted that entry into the DD camera market is likely, either by TEM manufacturers who would be well-placed to enter (either themselves or in collaboration with a third party), or by numerous suppliers of adjacent products (eg detectors)[85].

208. However, the CMA believes that the barriers to entry or expansion in the supply of DD cameras are significant (see paragraph 211onwards). The CMA has received no evidence to indicate that entry or expansion in the supply of DD cameras for use with TEMs is at all likely in the near future.

209. On the basis of this evidence, the CMA believes that the Merged Entity would face a very limited competitive constraint from current and potential suppliers of DD cameras.

[84] Section 11 of the Parties' Response to the Issues Letter, 29 November 2018.
[85] Paragraph 11.3 of the Parties' Response to the Issues Letter, 29 November 2018.

Conclusion on horizontal unilateral effects

210. For the reasons set out above, the CMA believes that Thermo Fisher and the Target are close competitors in the supply of DD cameras and that the remaining competitive constraints would not sufficiently constrain the Merged Entity. The Merged Entity would account for a very large proportion of all DD cameras supplied. The reduction of competition in the supply of DD cameras may lead to an increase in the price of DD cameras, reduced quality (in product or service) and/or reduced incentives to innovate. Accordingly, the CMA believes that the Merger gives rise to a realistic prospect of an SLC as a result of horizontal unilateral effects in the supply of DD cameras for use with TEMs worldwide.

Entry and expansion

211. Entry, or the expansion of existing firms, can mitigate the initial effect of a merger on competition, and in some cases may mean that there is no SLC. In assessing whether entry or expansion might prevent an SLC, the CMA considers whether such entry or expansion would be timely, likely and sufficient[86].

Entry and expansion downstream

212. Third party evidence indicated that entry into the downstream market for the supply of TEMs would require significant time and investment. One third party indicated that there would also be significant technical barriers for existing manufacturers of SEMs to expand into TEMs.

213. The Parties said that Tescan was an imminent new entrant in the supply of TEMs (Tescan is currently active in the supply of SEMs)[87]. The Parties added that [✂][88]. However, the CMA understands that Tescan's planned entry is in relation to lower-end TEMs, as opposed to the high-end TEMs supplied by Thermo Fisher[89]. Further, the CMA has received no evidence to suggest that Tescan's entry into TEMs will be in the near future. For these reasons, the CMA does not believe that it can rely on the entry of Tescan to address its concerns arising from the Merger. The Parties identified no other party which they believed had plans to enter the supply of TEMs.

---

[86] *Merger Assessment Guidelines*, from paragraph 5.8.1.
[87] [✂].
[88] Paragraph 1.4 of the Parties' Response to the Issues Letter, 29 November 2018.
[89] Parties' Response to Question 3(b) of RFI 2, dated 21 September 2018.

214. Evidence provided by third parties indicated that barriers to the development of a TEM are high. Third parties said that the development of a new TEM was a very complicated and difficult task.

215. The CMA notes that Zeiss recently exited the supply of TEMs indicating that it is not an attractive market to a new entrant.

216. The CMA believes that the evidence provided by third parties on the duration and cost of entry is consistent with the Parties' internal documents. These documents indicate Thermo Fisher's belief that the threat from new entrants is low. The Market Transmission Electron Global 2017 report states "*The chances that many start-ups and large firms will enter the TEM market are very low, considering its development and initial cost. The R&D cost for TEM is close to 50% of gross sale, and these TEMs are developed in collaboration with the universities and research institutes*"[90].

217. For the reasons set out above, the CMA believes that it cannot rely on entry or expansion in the supply of TEMs to be sufficiently timely, likely and sufficient to prevent a realistic prospect of an SLC as a result of the Merger.

Entry and expansion upstream

Cost and time of entry

218. Most third parties indicated that entry into the upstream market would be costly and take a long time, due to the complex and high-tech nature of the products involved and the strong reputation of the Parties in relation to those products.

    (a) In relation to filters, third parties provided evidence to suggest that it would take several years to enter (ranging from 5 years to 9 years), and longer still to build a strong reputation, and that it would cost between $1.5m and $5m.

    (b) In relation to DD cameras, third parties told the CMA that it would take 5 to 10 years to enter, and longer to win customers, and would cost between $5m and $50m[91].

[90] Attachment D24 to the Merger Notice.
[91] The Parties submitted that the figures in relation to DD cameras in particular were "*a gross overestimation of the time and expense required to develop a DD camera and does not match Gatan's or Thermo Fisher's experience*" (Paragraph 5.21 to the Parties' response to the Issues Letter, 29 November 2018.

(c) In relation to GI cameras, third parties estimated that it would take 2 to 5 years to enter and cost between $1m and $2m.

219. Whilst some of these figures provided by third parties were estimates, others were based on their own entry or attempted entry into the supply of each of the peripherals. Given the significant variation in the cost estimates provided by the different third parties, the CMA put more weight on the estimates from those with actual or attempted entry experience. The CMA found that, even considering the Parties' estimates or the lower bound in the ranges provided by third parties, the time and cost required to start supplying all three types of peripheral are high.

220. The Parties submitted that rival TEM manufacturers (ie JEOL and Hitachi) would have the skills to develop their own cameras and/or filters in-house, or could sponsor new entry, in a short timeframe and at limited cost.

221. The Parties said that, based on the Target's experience, the timeframe and cost for entry into DD cameras would be shorter and cheaper than presented by third parties. The Parties said that it would take less than [✂] and cost less than $[✂]. Similarly, for filters and GI cameras, the Parties estimates were lower: [✂] and a cost of below £[✂] for filters; and [✂] and £[✂] to £[✂] for GI cameras, depending on the quality of camera being developed[92][93].

222. The CMA noted that the Target has been active in the supply of GI cameras and filters since the 1980s, and in DD cameras since 2011/12. Its products have constantly evolved to reach the current models it supplies. The Parties suggested that, in relation to filters, its first product took around [✂] to develop, the second version (the K2 Quantum) took about an additional [✂], and the third version, which is currently supplied (the GIF continuum), took around an additional [✂] to develop[94]. The CMA understands that a similar evolution of product development has occurred in relation to both the Target's GI and DD cameras.

223. However, the Parties submitted that aggregate periods of development are not an appropriate comparator for assessing how long entry would take, and instead the CMA should consider only the time and cost to develop the first model of each product. [✂][95]. The Parties submitted that many of the costs incurred by Thermo Fisher and the Target when developing their products historically would not be incurred by JEOL and Hitachi now that technologies

[92] Paragraphs 5.19-5.31 of the Parties' response to the Issues Letter, 29 November 2018.
[93] [✂].
[94] Annex 1 to the Parties' response of 3 December 2018.
[95] Parties' response of 3 December 2018.

are more established and well-known[96]. Finally, the Parties also noted that the Target has launched a new generation of products for each of its filters, DD cameras and GI cameras in 2018, meaning that rival TEM manufacturers already have access to the latest technology[97].

224. The CMA believes that, although the aggregate of all development time is not an appropriate comparator to new entry or expansion by a third party, the Parties' cumulative investment in development should be taken into account when assessing the likelihood and timeliness of entry and expansion by rivals following the Merger.

Other barriers to entry

225. Third parties also pointed to other factors which make entry or expansion in the supply of filters, DD cameras or GI cameras with a sufficient scale to constrain the Merged Entity difficult. For example, the long life-cycle of these peripherals (between 7 and 10 years) means that sales are lumpy, increasing the time required for a new entrant to grow and establish its reputation. Evidence from third parties indicated that reputation and a strong track record are key factors for customers in choosing a supplier. Moreover, the development of peripherals requires significant development expenditure, which is not without its risks.

226. Third party evidence also indicated that hardware is just one component of the TEM system and that software is also very important. A TEM manufacturer would need to invest in software to enable a peripheral supplied by a new manufacturer to work. One third party noted that the Target's software platform, Digital Micrograph, which has been developed over the last 20 years, is used widely, to the extent that it has become an industry standard. This third party noted that the Target offers a full package service, supplying and installing the hardware and software. It said that it would be resource intensive, time-consuming and expensive for a new peripherals supplier to develop the necessary system integration and software components. This third party estimated that it would take in excess of three years, depending on investment, to develop software that could replace the Target's Digital Micrograph software.

[96] Paragraph 5.32 of the Parties' Response to the Issues Letter, 29 November 2018.
[97] Parties' Response to the Issues Letter, 29 November 2018.

Potential entrants

227. The Parties submitted that CEOS will soon be entering the filters market with a post-column filter to compete with the Target's filter. The Parties said that CEOS intends to bring this product to market in 2019[98]. However, CEOS told the CMA that its product will not provide the same software that the Target offers or be able to compete on the same scale as the Target, and that its entry is still around 1.5 to 2 years away.

228. The CMA noted that one of the Target's internal documents indicates [✂][99]. However, since this document is a due diligence report prepared explicitly in relation to the Merger, the CMA has not placed much weight on it.

Conclusion on entry and expansion upstream

229. For the reasons set out above, the CMA believes that it cannot rely on entry or expansion in the supply of filters, DD cameras and GI cameras to be sufficiently timely, likely and sufficient to prevent a realistic prospect of an SLC as a result of the Merger (in vertical effects or, in relation to DD cameras, in horizontal effects).

Countervailing buyer power

230. The Parties told the CMA that both EM manufacturers and EM end-users have countervailing buyer power. The Parties submitted that they will continue to face strong countervailing buyer power post-Merger from:

    (a) the Target's EM manufacturer customers, as JEOL and Hitachi are large and sophisticated multi-national companies; and

    (b) end-user customers, as EMs are ordered infrequently with substantial delivery times, which enables end-users to exert buyer power.

231. The CMA believes that the Merged Entity's market power in the supply of filters, DD cameras and GI cameras and in the supply of TEMs means that EM manufacturers and end-users would have little or no buyer power. As explained above in the competitive assessment, customers and competitors have consistently told the CMA that, post-Merger, both EM manufacturers and EM end-users would have weak or no alternatives to the Merged Entity in the near term. In the longer-term, the CMA recognises that alternatives may arise, but, as set out above in relation to entry and expansion, the CMA did not

---

[98] Paragraph 5.17(iii) to the Parties' Response to the Issues Letter, 29 November 2018. http://www.bt.pa.msu.edu/CPO-10/talks/17Wed/PM1/P0G/17Wed_PM1_1400_P0G_Kahl.pdf
[99] [✂]. Slide 3 of Attachment D12 to the Parties' Merger Notice.

receive evidence that such alternatives would be timely, likely and sufficient to address the competition concerns arising from the Merger.

Third party views

232. The CMA contacted customers and competitors of the Parties, including end-users such as universities who purchase EMs and peripherals. A high proportion of third parties expressed concerns about the Merger, the majority of which related to the Merged Entity's ability and incentive to foreclose its rivals.

233. Third party comments have been taken into account where appropriate in the competitive assessment above.

Conclusion on substantial lessening of competition

234. Based on the evidence set out above, the CMA believes that it is or may be the case that the Merger may be expected to result in an SLC as a result of vertical effects arising from foreclosure in the supply of filters, DD cameras and GI cameras to competing TEM manufacturers at a worldwide level and horizontal unilateral effects in relation to the supply of DD cameras for use with TEMs worldwide.

Decision

235. Consequently, the CMA believes that it is or may be the case that (i) arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation; and (ii) the creation of that situation may be expected to result in an SLC within a market or markets in the UK.

236. The CMA therefore believes that it is under a duty to refer under section 33(1) of the Act. However, the duty to refer is not exercised whilst the CMA is considering whether to accept undertakings under section 73 of the Act instead of making such a reference[100]. The Parties have until 28 December 2018[101] to offer an undertaking to the CMA[102]. The CMA will refer the Merger for a phase 2 investigation[103] if the Parties do not offer an undertaking by this date; if the Parties indicate before this date that they do not wish to offer an

[100] Section 33(3)(b) of the Act.
[101] Section 73A(1) of the Act.
[102] Section 73(2) of the Act.
[103] Sections 33(1) and 34ZA(2) of the Act.

undertaking; or if the CMA decides[104] by 7 January 2019 that there are no reasonable grounds for believing that it might accept the undertaking offered by the Parties, or a modified version of it.

Andrea Gomes da Silva
Executive Director for Markets and Mergers
Competition and Markets Authority
19 December 2018

[104] Section 73A(2) of the Act.