CIRPASS 2
Digital Product Passport

DPP GRANULARITY LEVEL OPTIONS FOR TEXTILES/APPAREL

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Abstract	This paper provides an analysis of the implementation of mandatory Digital Product Passports (DPPs) for apparel at three potential levels of granularity of DPP information: model, batch, and item. This document was prepared and reviewed collaboratively by the partners of the CIRPASS-2 consortium, with the goal of informing the ongoing discussion in the ESPR Ecodesign Forum on a delegated act for textiles (including apparel).
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GLOSSARY

List of Definitions, Abbreviations and Acronyms	
Apparel	Clothing and clothing accessories intended to be worn on the human body
DPP	Digital Product Passport
EC	European Commission
EPR	Extended Producer Responsibility
ERP	Enterprise Resource Planning
ESG	Environmental, Social, Governance
Garment	A single piece of clothing
LCA	Life Cycle Analysis
LCI	Life Cycle Inventory – The data points needed to perform an LCA
OEM	Original Equipment Manufacturer
POS	Point of Sale
REO	Responsible Economic Operator (legally responsible for issuing DPPs)
R-Strategy Actors	Value-chain stakeholders involved in the implementation of circular economy business models
UPI	Unique Product Identifier
MSA	Market surveillance authorities
PEF	Product Environmental Footprint
PRODUCT MODEL	The term 'model' usually refers to a version of a product of which all units share the same technical characteristics relevant for the eco-design requirements and the same model identifier (source: ESPR)
PRODUCT BATCH	Please see the discussion on the definition of batch' in section 2.2.
PRODUCT ITEM	Product item refers a single unit of a product, allowing its unique identification, and distinguishing it from other product units within the same product model
SUPPLY CHAIN TRACEABILITY	Supply chain traceability is the ability to track and trace the materials and components used for manufacturing the final product, including logistics events until the product is placed on the market.

1 INTRODUCTION

This paper provides an analysis of the implementation of mandatory Digital Product Passports (DPPs) for apparel at three potential levels of granularity of DPP information: model, batch, and item. This document was prepared and reviewed collaboratively by the partners of the CIRPASS-2 consortium, with the goal of informing the ongoing discussion in the ESPR Ecodesign Forum on a delegated act for textiles (including apparel).

While the analysis contained in this report is applicable to most product categories, the Textiles/Apparel industry has specific characteristics:

- decades of decreasing retail prices as production moved to low-cost countries,
- relatively low rate of repairs and recycling (due to low price, current technologies, infrastructure, best practices, product designs, etc.),
- most textiles/apparel businesses in the EU and in the world are SMEs or even micro businesses,
- a large majority of companies have small shares of the market while, and in recent years, very few large companies with very low-priced product ranges have gained large market share,
- the supply chains are often global, complex and fragmented.

These characteristics were considered while preparing this document.

This paper examines the advantages and disadvantages of different levels of DPP granularity, with a focus on the implications of mandating model or batch-level passports while still requiring item-level identifiers. Item-level identifiers can easily adapt to coarser granularity (batch or model) DPP information models, but the reverse is harder: if only model or batch-level identifiers are mandatory, introducing item-level identifiers later demands significant adjustment. Therefore, this paper will also highlight the benefits of item-level tagging, particularly for circular economy use cases and in a future with much longer product life cycles, where item-specific data enables data driven management of products, both upstream and downstream, analysis of consumer behavior and dynamic updates throughout a product's life cycle.

From a cost–benefit perspective, this issue becomes even more evident. Once the initial investment in labelling technologies and supporting IT systems is made, **the marginal cost of assigning an item-level identifier is either negligible or only somewhat higher than assigning an identifier at model or batch level[1]. However, the potential advantages of item-level identifiers are significantly greater.** Importantly, data management does not need to be restricted to a single level of granularity. Information can still be structured and analysed at the model, batch, or item level, but when it is ultimately linked to an item-level identifier, the system gains both flexibility and the capacity to deliver maximum utility over time. This is particularly valuable for circular economy applications, where item-level visibility enables accurate tracking, reuse, and recovery of materials throughout a product's life cycle.

1 As a result, many brands are already doing this voluntarily, for internal business reasons.

2 GRANULARITY LEVELS FOR MANDATORY TEXTILE/APPAREL DPP

2.1 MODEL LEVEL

In this section, CIRPASS-2 partners have examined key aspects related to **model-level information requirements** and **model-level product identifiers** and assessed their implications for various value-chain actors and public authorities.

2.1.1 MODEL-LEVEL GRANULARITY FOR MANDATORY INFORMATION REQUIREMENTS

The good

A key advantage of model-level information granularity is its lower demand on IT systems and infrastructure, as a single information set can represent an entire product model, with no variation across production batches.

The model-level information granularity corresponds to data that are currently in most current IT systems, the ERP in particular.

Model-level information granularity minimizes the need to manage additional data at more detailed levels.

In turn, this ultimately reduces the costs associated with developing and maintaining more complex solutions. This particularly benefits SMEs and smaller actors, enabling them to implement DPPs efficiently without heavy IT investments.

Model-level information granularity closely aligns with existing product labeling practices.

Information that can be meaningfully captured at this granularity includes eco-labels, design certifications, durability features, and washing or repairability instructions.

A DPP with model-level information granularity means that there is no need to define an additional pre-purchase-specific “DPP”. Model-level information granularity is indeed the only suitable approach for e-commerce pre-purchase information, as customers typically cannot identify the exact item they will purchase. While of course DPPs with batch and item-level information granularity can contain model-level information, access to this information by scanning the data carrier is not possible in pre-purchase situations unless the customer has physical access to a specific item’s data carrier.

Model-level information granularity means that certain data points correspond to average values (e.g. PCF, water consumption). This has some positive aspects because of the inherent lack of precision of specific life cycle inventory (LCI) data and the importance of a brand’s overall (average) responsible behavior (e.g. seasonal manufacturing electricity sourcing) Thus, high granularity values might eliminate outliers that are not representative of a brand’s overall environmental and social impact.

If the model level mandatory information includes data related to textiles/apparel product color and size, this corresponds to existing industry practices for product identification (GTIN).

The bad

Especially for large brands and due to the existence of production facilities in different countries producing different batches of the same model, the same product model can have a different supply chain. This means that supply-chain transparency is limited:

- country of origin cannot be determined because identical product models may be produced in multiple locations, thus country of origin could possibly correspond to a list of possible countries,

- source of raw materials (with possible different composition) and production steps/facilities cannot be determined.

This could impact the DPP's usefulness for market surveillance authorities.

Consumers' reaction to vague data or data that has been proven to be inaccurate could impact DPP credibility and perceived usefulness.

2.1.2 MODEL-LEVEL GRANULARITY FOR PRODUCT IDENTIFIERS

The good

The issuance of identifiers and data carriers becomes straightforward and cost-effective, since the same identifier can be applied to all items of a given product.

The bad

A DPP with model-level product identifier granularity makes it more difficult to integrate more granular data from later life cycle phases, such as actual use, resell, repairs, reuse, sorting or end-of-life management events. Indeed, this creates challenges: who would host the data, how would the events data be related to the existent DPP, how would the user of the DPP be able to see both the initial DPP and the events data if the two are not hosted at the same weblink, ... Model-level DPP identifiers cannot capture item-specific information that might include e.g. tips or stories associated with 'pre-loved' goods, or repair events undergone by a specific technical garment (e.g. fire-protective jacket). Should economic operators wish to enable this on a voluntary basis, because individual units are not identifiable, these have to be retagged for this purpose with an item-level product identifier and linked to a new data repository which introduces costs and effort overheads. This limitation is particularly relevant for apparel-as-a-service business models, where continuous tracking of individual products is crucial.

Model-level DPP product identifier granularity presents significant limitations for product recall scenarios, where typically only items from specific batches are affected. In a data-driven economy, the goal of recalls is to minimize disruption by targeting only the affected items. However, with model-level granularity, it is impossible to distinguish between faulty and non-faulty product items within the same model. As a result, recalls must often include all items of that model, leading to unnecessary costs, reputational damage, and logistical burdens that could be avoided with more granular tracking.

2.2 BATCH LEVEL

In this section, the paper assumes that batch-level DPP information granularity is adopted for apparel products. CIRPASS-2 partners have identified both challenges and benefits associated with **batch-level information requirements** and **batch-level product identifiers** and assessed their potential impact on value-chain actors and public authorities.

A major current challenge with batch-level data and identifiers lies in the lack of a precise definition of a "batch", and current market practices that do not support batch level identification (e.g., continuous production operations alike polyester filament yarn production line, continuous dyeing range, automatic fabric stenter and finishing line). The term can be interpreted differently by various market actors, leading to inconsistencies in reporting and data management. While moving from model-level to batch-level granularity offers the potential for more precise information and enhanced traceability, this lack of clarity complicates implementation. To address this, public authorities must provide clear and enforceable definitions of a 'product batch' to ensure consistency and avoid operational and regulatory difficulties:

ESPR batch definition: the term 'batch' "usually refers to a subset of a specific model composed of all products produced in a specific manufacturing **plant** at a specific moment in time". We assume that this means Tier-1 traceability and that used materials can come from different batches.

Production batch definition: the term 'batch' usually refers to a subset of a specific model composed of all products produced in a specific manufacturing **supply chain** (Tier-N) over a specific moment of time.

Shipping batch definition: items of a given product model that have been produced (i.e. a production batch as defined above) and shipped together and have the same environmental footprint.

Despite our efforts to clarify the definition of batch, some actors in the industry register in their IT systems sub-volumes of production orders as 'lots'. These might serve to identify different shades of the same fabric, or different fabrics, or even different clients. This adds complexity in regard to achieving a common understanding of what is a batch in this industry.

2.2.1 BATCH-LEVEL GRANULARITY FOR MANDATORY INFORMATION REQUIREMENTS

The good

Depending on the batch definition applied, batch-level DPPs can capture ESG-related datapoints and ensure supply-chain transparency because each batch represents a discrete group of products with shared production characteristics, such as:

Batches of raw material, assuming Tier-N traceability can be ensured,
Production facilities, processes and time
Fiber compositions.

Assuming it can be implemented, this level of granularity allows companies to accurately link materials and facilities to specific batches, track supplier compliance, and calculate sustainability metrics such as carbon footprint or energy use for each batch rather than relying on model-wide averages.

It also enables targeted interventions (e.g. recalls and ESG audits), to focus on specific batches, reducing inefficiencies, and waste.

Batch-specific information enhances transparency, accountability, and overall ESG performance across the value chain and provides more accurate product information to stakeholders.

In addition, batch-level granularity drives technological readiness among value-chain partners, who are required to provide more accurate and timely data. This might foster improved automation in data collection and processing, enabling more efficient operations and reducing errors. The resulting increase in data reliability introduces the potential for additional business value across the ecosystem, ultimately benefiting reuse, repair, and recycling operators (CEOPs) and supporting broader circular economy objectives.

Compared to model-level DPPs, batch-level granularity provides market-surveillance authorities with greater oversight, enabling more accurate monitoring.

The bad

The most difficult issue with regards to batch level information requirements is the ambiguity of the batch definition itself, as described above. Thus, the theoretically positive arguments above are hard to implement in the real world.

For online selling, it will not be possible to distinguish products from different batches. If data is different for each batch, the consumer will not be reliably informed about the product they are considering purchasing, as the specific item they will receive may be from a different batch and have different characteristics. Solving this would require online selling platforms to only display the model-level part of the DPP or the creation of a dedicated 'online model-level DPP' with associated model-level identifier and associated web link to access the model-level data. However, this would lead to a situation with different information granularity available for eCommerce versus physical retail.

Batch-level life cycle data may be confusing or even misleading for the end users from an overall ESG perspective, e.g. batches may have a lower carbon footprint in summer (because the share of renewable electricity used in production is higher) than those produced in the winter.

2.2.2 BATCH-LEVEL GRANULARITY FOR PRODUCT IDENTIFIERS

Batch level information requires batch or item-level granularity identifiers.

The bad

Many apparel companies have centralized production of labels/data carriers/identifiers, and these are often produced well in advance of garment production which can possibly take place in different supply-chains and therefore in different production batches. One challenge with batch level identification is that it can be difficult to know upfront the number of labels/data carriers to produce with specific batch identifiers.

As described above, products from the same production batch can also be part of different shipping batches, with different carbon footprints, and this information might not be available at the time of production.

In general, batch level granularity for product identifiers complicates operations and reduces production and distribution flexibility without sufficiently clear upsides. Due to this, and if labels are not printed in real-time at the factory, batch level in apparel is better handled through item-level identifiers since it allows for more post-production flexibility.

2.3 ITEM LEVEL

In this section, the paper assumes that item-level DPP information granularity is adopted for apparel products. CIRPASS-2 partners have identified both challenges and opportunities associated with **item-level information requirements** and **item-level product identifiers** and assessed their potential impact on value-chain actors and public authorities.

2.3.1 ITEM-LEVEL GRANULARITY FOR MANDATORY INFORMATION REQUIREMENTS

The good

Item-level information granularity is the most suitable approach for supporting circular economy objectives, as it allows life cycle data to be updated after market launch and consumer purchase, regardless of the corresponding data being mandatory or voluntary. This capability enables holistic life cycle management and more effective implementation and monitoring of Extended Producer Responsibility (EPR) policies, ensuring that each product's environmental performance is tracked throughout its entire life. This provides useful information for brands to enhance product quality.

By capturing detailed, item-specific information, item-level DPPs enable the implementation of several "R Strategies" that less granular DPPs cannot support to the same extent. Quantitative data on resell, repair, sorting and recycling events can be dynamically updated, enhancing repair use-cases, improved inventory management, maintenance tracking, and pricing decisions. This facilitates detailed reporting on product lifetime and other circular economy metrics while supporting value-added post-sale services, such as resell, maintenance, and repair. Such services increase consumer satisfaction (e.g., consumer demand for resell value is increasing), product lifetime and product differentiation.

Item-level tracking is particularly valuable for 'product-as-a-service' models, providing benefits for higher valued long lifespan apparel products that require professional upkeep or safety requirements.

It also supports ownership claims, anti-counterfeit and grey market measures, protecting brands and adding consumer value, while facilitating secure resale and secondary-market circulation.

Item-level granularity provides similar advantages as production batch-level granularity for market-surveillance and recall as batch-level recall-related information can be added to a DPP identified at the item-level.

Item-level granularity for information requirements avoids the complexities related to the definition of batch or model.

The bad

Some information like PEF is more appropriately given on aggregated levels, such as Model or Batch, as in most cases the overall performance of a product or even a brand (e.g. a yearly average) is more important than the performance of each individual item.

A mandatory item-level information model could otherwise only concern downstream life cycle event data. Because of the current lack of repair, sorting, and recycling infrastructure and standardized processes for managing products at the item-level (requiring writing back into the DPP), it would be unreasonable to require such information today among the mandatory information requirements. However, it should be encouraged, and perhaps incentivized, on a voluntary basis. For the reasons listed above ('The good'), many brands are already adopting this approach.

For online selling, it will not be possible to distinguish between specific items. If data is different for each item, the consumer will not be reliably informed about the product they are considering purchasing, as the specific item they will receive may have different characteristics. Solving this would require online selling platforms to only display the model-level part of the DPP or the creation of a dedicated 'online model-level DPP' with associated model-level identifier and associated web link to access the model-level data. However, this would lead to a situation with different information granularity available for eCommerce versus physical retail.

2.3.2 ITEM-LEVEL GRANULARITY FOR PRODUCT IDENTIFIERS

The good

Products with item-level identifiers can still be associated with coarser granularity level DPP information. For example, items can still have common batch or model-level information requirements.

Item-level identifiers do not introduce the complexity of having to produce and ship labels for batch specific identifiers to different production facilities. On the contrary, a bulk stock of item-level identifiers and labels reduces complexity and keeps flexibility in the supply chain.

Furthermore, item-level granularity improves inventory accuracy, streamlines supply-chain operations, and supply-chain traceability. Even traditional business models benefit economically from these capabilities.

Item-level identifiers are already common in the industry due to the voluntary adoption of RFID for inventory management and theft protection. Consequently, many IT systems are already compatible with item-level identifiers.

The bad

The following two statements reflect a current lack of consensus amongst consortium partners:

Issuing item-level product identifiers might introduce a slightly increased cost[2].

Issuing item-level product identifiers might introduce a very significant increased cost, that (depending on product, production volumes, etc.) may represent a significant share of the product's price, production cost and margin capacity[3].

3 CONCLUSION AND RECOMMENDATIONS

There are pros and cons to every alternative, however, the above discussion led to several recommendations:

R1: The mandatory information granularity and the mandatory product identifier granularity may not be identical, depending on specific product groups.

It is important to clearly distinguish between the mandatory information requirements of the DPP and the level of identifier granularity embedded in the data carrier. Without this clarity, there is a risk of confusion among value-chain actors, leading to inconsistent implementation and unnecessary complexity. This should be made clear in product-specific ESPR delegated acts.

This distinction provides flexibility to adapt to different product groups in the textiles/apparel domain, depending on sub-category, post-sale potential, or some other reason. E.g. for socks, the DPP data carrier could be on the packaging with a DPP identifier on the same granularity level as the information requirements.

R2: Item-level product identification should be encouraged in order to anticipate the future expansion of DPP to adopt broader practices of Circular Economy.

Product identification granularity that maximizes the economic value enabled by the DPP should be encouraged to achieve the full ambition of the ESPR objectives. Building strong business cases will help ensure adoption, as companies are more likely to invest in systems that not only ensure compliance but also deliver operational efficiencies, cost savings, and new market opportunities. Item-level identifiers foster green innovation and new business models.

The above reasons explain the already observed choice of a considerable part of the industry to autonomously move towards the identification of individual items, e.g. to improve inventory accuracy, as we have seen with the widespread adoption of RFID in this industry.[4]

Because product identification granularity is a decision that will remain with the industry for a long time, due to its deep impact on production and logistics processes, preparing for a future that is serialized makes sense whenever reasonably possible.

R3: In the case that item-level identifiers become mandatory, regulatory authorities should support SMEs in their adoption.

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[2] Labelling solution providers inform us that serialization typically represents a marginal additional cost compared to non-serialized labels. While costs can vary significantly depending on multiple factors such as solution setup, print volumes and service scope, price difference estimates of printing costs between serialized and non-serialized labels is around 5 USD per 1000 labels and can go down to 3 USD for large volumes. To this should likely be added item-specific data management costs.

[3] However, many brands are already using item level identifiers with RFID, even in low-cost products.

[4] Accenture Covid-19 Consumer Pulse Research November 26, 2021 to December 10, 2021 https://www.accenture.com/content/dam/accenture/final/a-com-migration/r3-3/pdf/pdf-155/accenture-rfid-in-retail.pdf

To ensure this adoption is feasible for all actors, especially the SMEs (that dominate the textile sector), the Commission should consider phased-in timelines or support mechanisms for implementing item-level serialization. A pressure-relief transition plan to support SMEs in managing this extra cost should be prepared.

R4: Clear and standardized definitions for a batch (ESPR batch, production batch, shipping batch, etc.) should be introduced to support batch-level product identification and avoid operational inefficiencies in logistics and manufacturing.

The implementation of batch-level product identification requires clear, standardized definitions of what constitutes a "batch." Currently, the distinction between **ESPR batch, production batch, and shipping batch** for businesses is ambiguous, with a risk of leading to inconsistencies in data reporting, traceability, and logistics.

It is recommended that global standards are established and enforced for batch definitions to ensure interoperability in business use and in regulatory alignment. Adoption delays, costs, and risks in adopting these definitions will need to be considered.

R5: Although it may seem counter-intuitive to consider that item or batch-level granularity information on a product's environmental impact is less useful and precise than averaged values, most useful data is a result of aggregation and averaging because it is almost impossible, impractical, and unnecessary to have exact specific data values for individual items. Hence, model-level mandatory information granularity should be preferred as it is sufficient to achieve many of the goals of the ESPR.

Because of the complexity of defining what is a batch in the fashion industry item or batch-level PEF calculations are difficult to compare and possibly less relevant for the end-consumer.

R6: Because of the possibility of different mandatory granularity levels for information requirements and product identification requirements, the DPP system architecture (including the EU Registry and EU Portal) should be designed to support different combinations of product identifier granularity with model or batch level information requirements.

This additionally provides flexibility to Economic operators wishing to adopt finer product identification granularity than mandated.

R7: Looking further beyond the introduction of the first generation of DPPs, in order to anticipate the role of second generation DPPs in improving the traceability of products, industry agreements on clear definitions of 'batch' and/or 'Tier-N' suppliers are required.

In the shorter term, mandatory product identification at the item level prepares the grounds for this. This also supports economic operators who are willing to provide more detailed traceability data on a voluntary basis.