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"Digital Orthotic technologies"

The case for a digital supply chain in foot orthoses provision

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- ✓ *Traditional vs. digital orthotic workflow*
- ✓ *New technologies and approaches*

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SMARTPIF

SMART TOOLS for the prescription of INSOLES and FOOTWEAR

This project is funded by the European Union

FP7 2012-1

SME GA n. 312573

www.smartpif.eu

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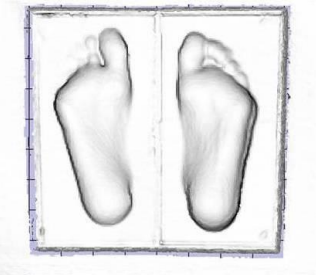
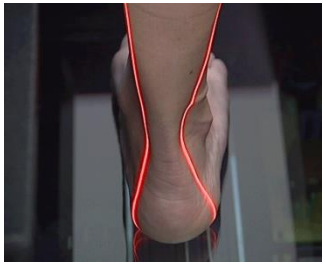
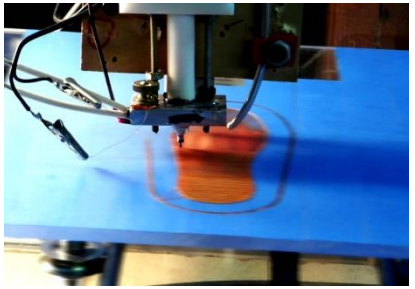
Digital orthotic workflow

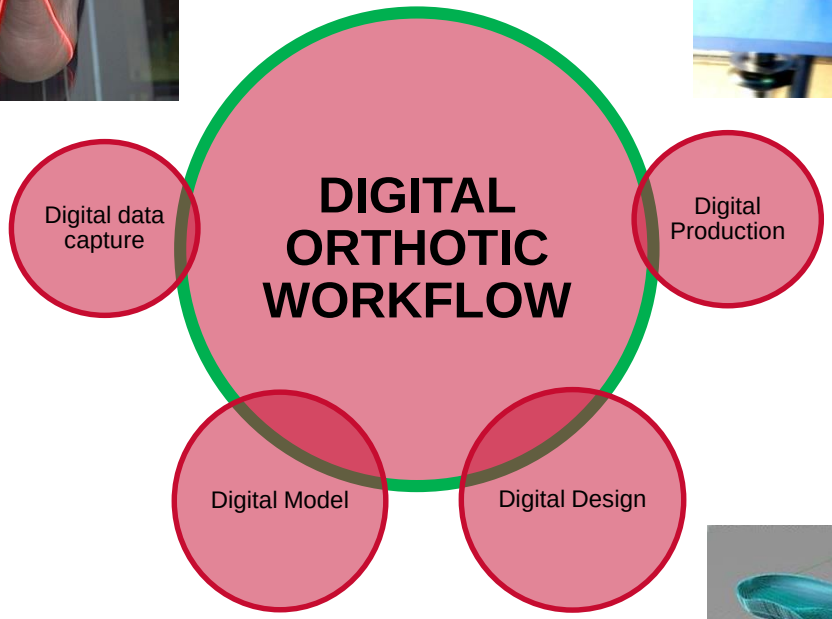


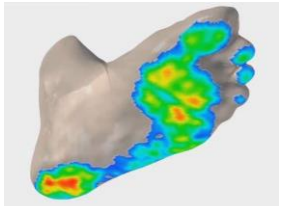




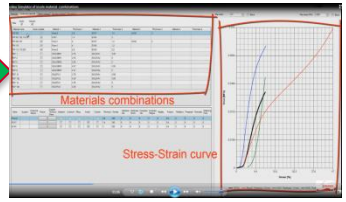
Characterise feet/patient

Improved foot health/service

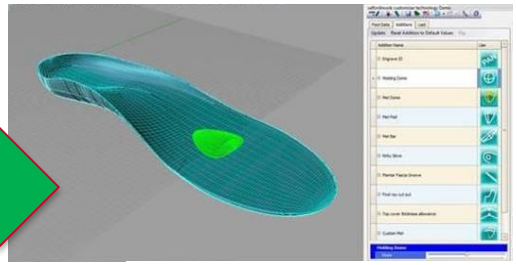




Static/ Dynamic behaviour



Models of feet and orthotics



Digital Processes

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Traditional supply chain

CLINICAL setting

Prescription
- Diagnosis
- Define FO shape
- Choose materials

Supply Data
- Foot shape
- Photo
- Other….

INDUSTRY

Design FO
- Geometry
- Materials

Make FO
- Workflow
- Quality

Supply FO
- To clinician
- To patient

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DIGITAL supply chain

1 Prescription
- Diagnosis
- Define FO shape
- Choose materials

2 Supply Data
- Foot shape
- Photo
- Other….

3 Design FO
- Geometry
- Materials

4 Make FO
- Workflow
- Quality

5 Supply FO
- To clinician
- To patient

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Foot shape capture

ORIGINAL ARTICLES

Ability of Foot Care Professionals to Cast Feet Using the Nonweightbearing Plaster and the Gait-Referenced Foam Casting Techniques

Leslie C. Trotter, DC, CPed(C), MBA*
Michael Raymond Pierrynowski, PhD†

Background: We examined the ability of foot care professionals to consistently capture the forefoot-to-rearfoot angular relationship of a single-cast foot.

Methods: Eleven Canadian certified pedorthists each cast a single foot twice using the plaster of Paris and foam box techniques. Three independent raters subsequently measured the resultant casts. Statistical analysis of the data provided generalizability coefficient estimates (ρ^2) of the intracaster, intercaster, and rater reliabilities.

Results: Intracaster reliabilities were excellent when the plaster and foam box techniques were used (ρ^2 = 0.831 and 0.939, respectively). The casters were more intrareliable when foam was used (F = 2.755, P = .003). Intercaster reliabilities were poor for both techniques (ρ^2 = 0.410 and 0.425). Although, intrarater reliability was excellent (ρ^2 = 0.882), interrater reliability was poor (ρ^2 = 0.418).

Conclusion: Although plaster of Paris casting is widely perceived by the foot care com-

	Intra	Inter
PoP	0.83	0.41
Foam Box	0.93	0.42

and is considered by many to be the gold standard.[4,5] The semiweightbearing posture with foam, however, is also popular because it is quicker than plaster.[3] Foot care professionals who advocate either the plaster or

ship. Chuter et al[6] agree that the purpose of obtaining the forefoot-to-rearfoot relationship is to capture the standardized posture of the foot. This concept was initially introduced by Root et al[5] and is widely as-

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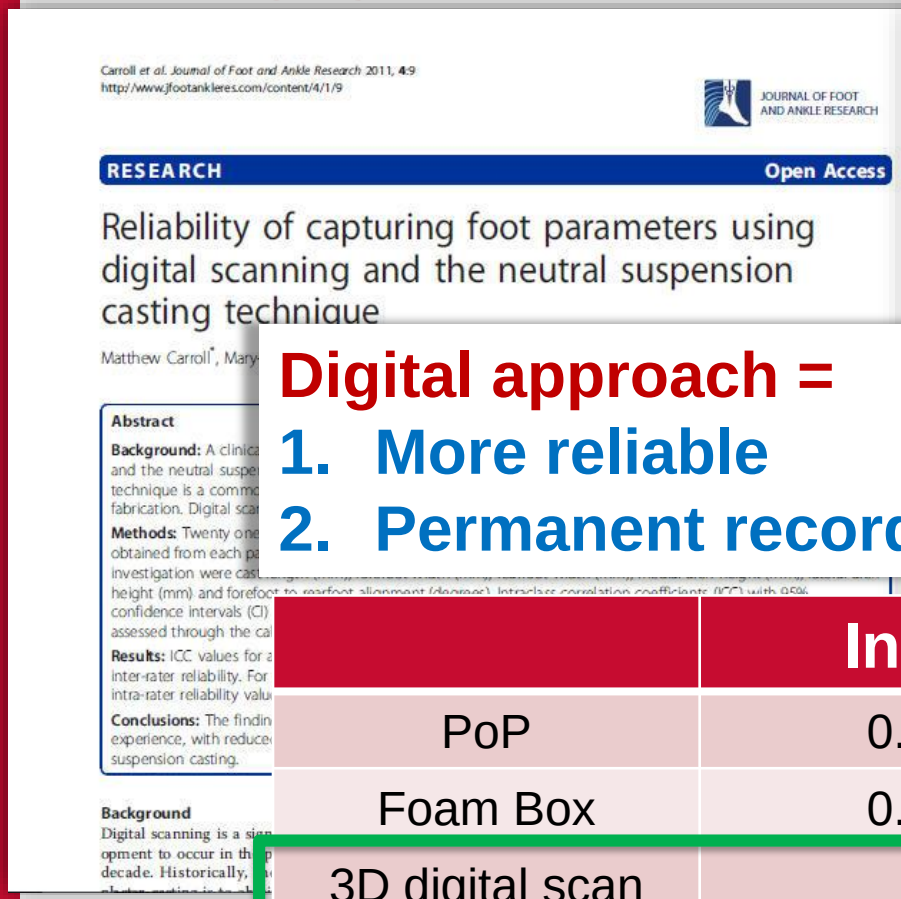
Foot shape capture


Carroll et al. Journal of Foot and Ankle Research 2011, 4:9
http://www.jfootankleres.com/content/4/1/9

JOURNAL OF FOOT AND ANKLE RESEARCH

RESEARCH Open Access

Reliability of capturing foot parameters using digital scanning and the neutral suspension casting technique

Matthew Carroll*, Mary

Abstract

Background: A clinic
and the neutral suspe
technique is a commo
fabrication. Digital sca

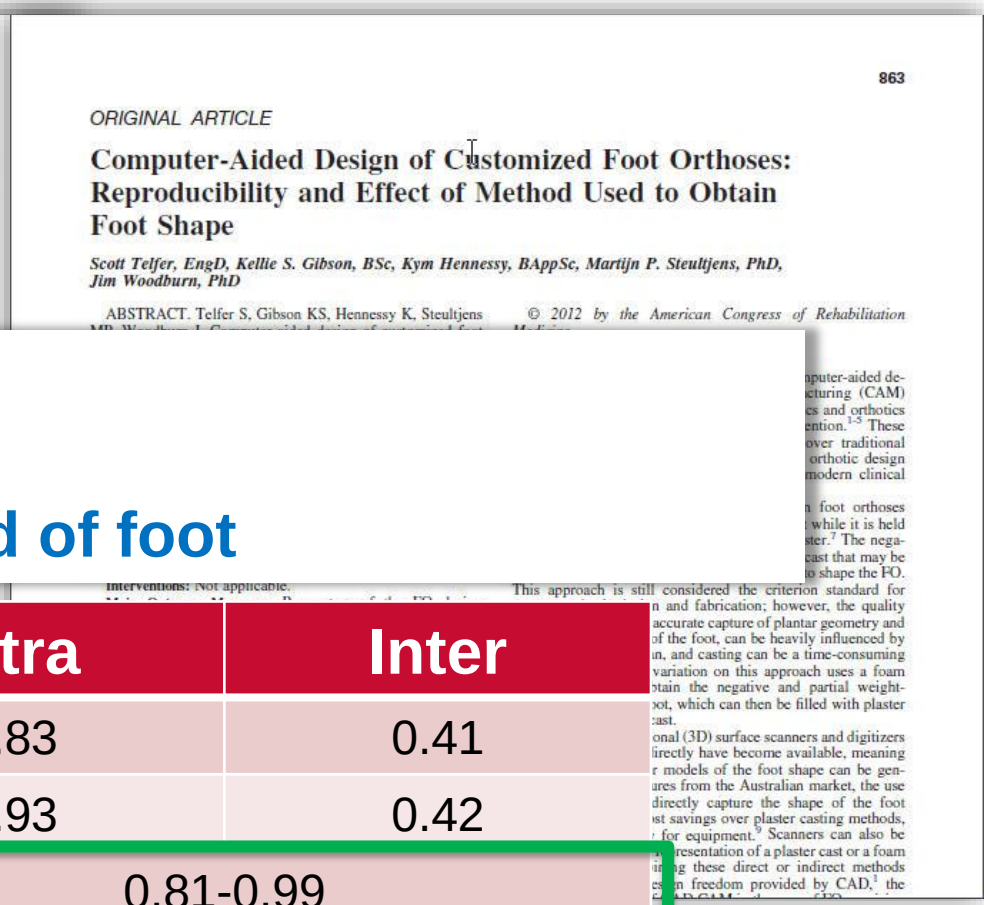
Methods: Twenty one
obtained from each pa
investigation were cas
height (mm) and forefoot
confidence intervals (CI)
assessed through the cal

Results: ICC values for a
inter-rater reliability. For
intra-rater reliability valu

Conclusions: The findin
experience, with reduce
suspension casting.

Background

Digital scanning is a sig
opment to occur in th
decade. Historically,


863

ORIGINAL ARTICLE

Computer-Aided Design of Customized Foot Orthoses: Reproducibility and Effect of Method Used to Obtain Foot Shape

Scott Telfer, EngD, Kellie S. Gibson, BSc, Kym Hennessy, BAppSc, Martijn P. Steultjens, PhD, Jim Woodburn, PhD

ABSTRACT. Telfer S, Gibson KS, Hennessy K, Steultjens

© 2012 by the American Congress of Rehabilitation

Interventions: Not applicable.

This approach is still considered the criterion standard for n and fabrication; however, the quality accurate capture of plantar geometry and of the foot, can be heavily influenced by in, and casting can be a time-consuming variation on this approach uses a foam btain the negative and partial weight- ot, which can then be filled with plaster cast.

onal (3D) surface scanners and digitizers irectly have become available, meaning r models of the foot shape can be gen- ares from the Australian market, the use directly capture the shape of the foot st savings over plaster casting methods, for equipment.[9] Scanners can also be resentation of a plaster cast or a foam g these direct or indirect methods n freedom provided by CAD,[1] the

Digital approach =

1. **More reliable**
2. **Permanent record of foot**

	Intra	Inter
PoP	0.83	0.41
Foam Box	0.93	0.42
3D digital scan	0.81-0.99	
PoP	0.36-0.99	

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DIGITAL supply chain

1 Prescription
- Diagnosis
- Define FO shape
- Choose materials

2 Supply Data
- Foot shape
- Photo
- Other….

3 Design FO
- Geometry
- Materials

4 Make FO
- Workflow
- Quality

5 Supply FO
- To clinician
- To patient

4D foot scanner

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Presc
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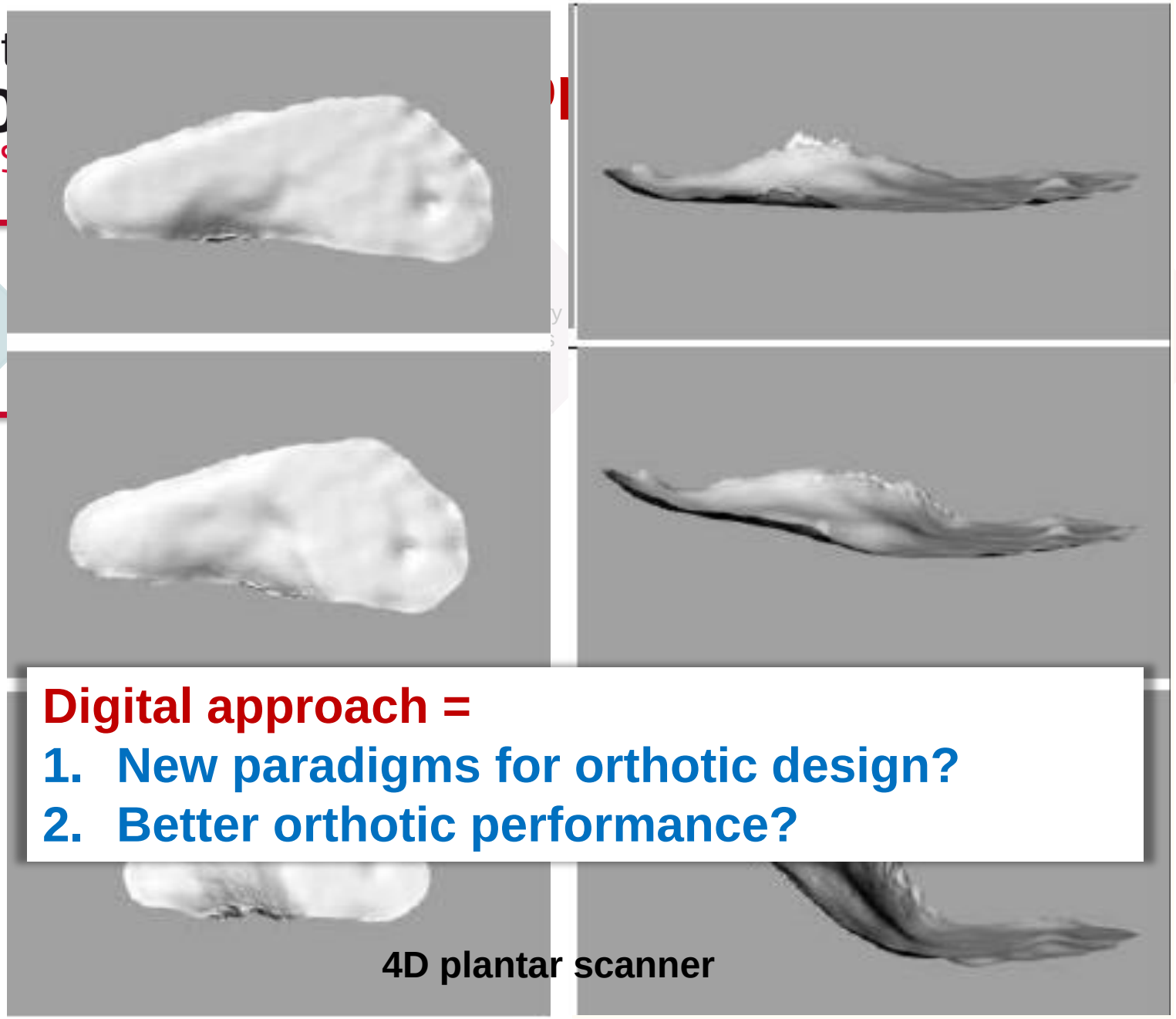
- Diagnosis
- Define FO shape
- Choose materials



Digital approach =

1. **New paradigms for orthotic design?**
2. **Better orthotic performance?**

4D plantar scanner

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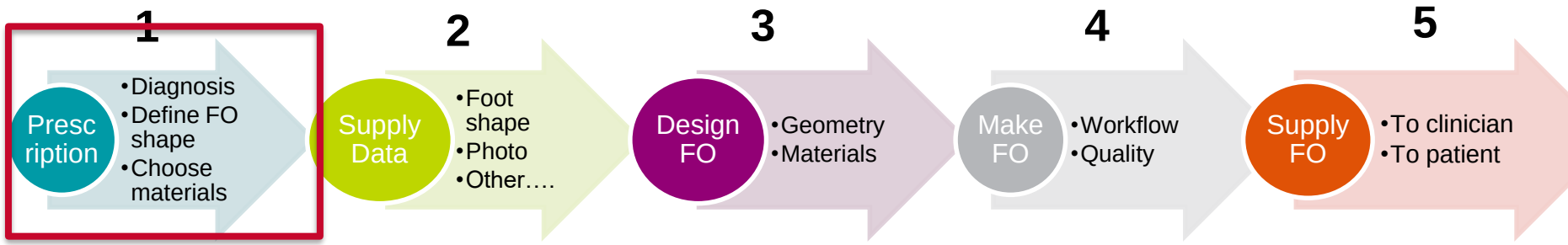
DIGITAL supply chain



RightShoes

Digital Challenge = patients are ahead of professionals in technology use

Digital Opportunity = Patient owns data, engagement

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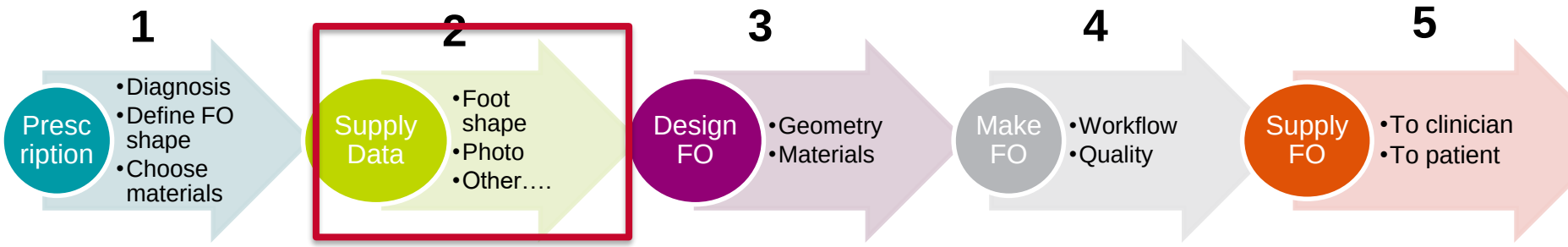
DIGITAL supply chain



www…..

- ✓ Prescribe an orthosis
- ✓ Clinician can review prescriptions
- ✓ Clinician defined templates for rapid prescription **(<1 minute)**
- ✓ Validation – no missing data, no/less misinterpretation
- ✓ Visualise and share with the patient – to educate, engage, co-create
- ✓ Measure outcome – patient voice on their terms

Digital =

1. **Permanent record of data and prescription**
2. **Less errors/guessing**
3. **Outcome measures**

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Williams et al. Journal of Foot and Ankle Research 2013, 6:17
http://www.jfootankleres.com/content/6/1/17

JOURNAL OF FOOT AND ANKLE RESEARCH

RESEARCH Open Access

Foot orthoses for the management of low back pain: a qualitative approach capturing the patient's perspective

Anita E Williams[1*], Lindsay A Hill[2] and Christopher J Nester[3]

ABSTRACT**: For these participants, foot orthoses appeared to be effective. However, **the main influence on this outcome was the consultation process and a patient focused approach.

The consultation was an opportunity for fostering mutual understanding, with verbal and visual explanation reassuring the patient and this influenced the patient's beliefs, their engagement with the foot orthoses (physical) and their experience of low back pain (psychological)

Digital =

1. **Validated education**
2. **Engagement, co-creation of health outcomes**

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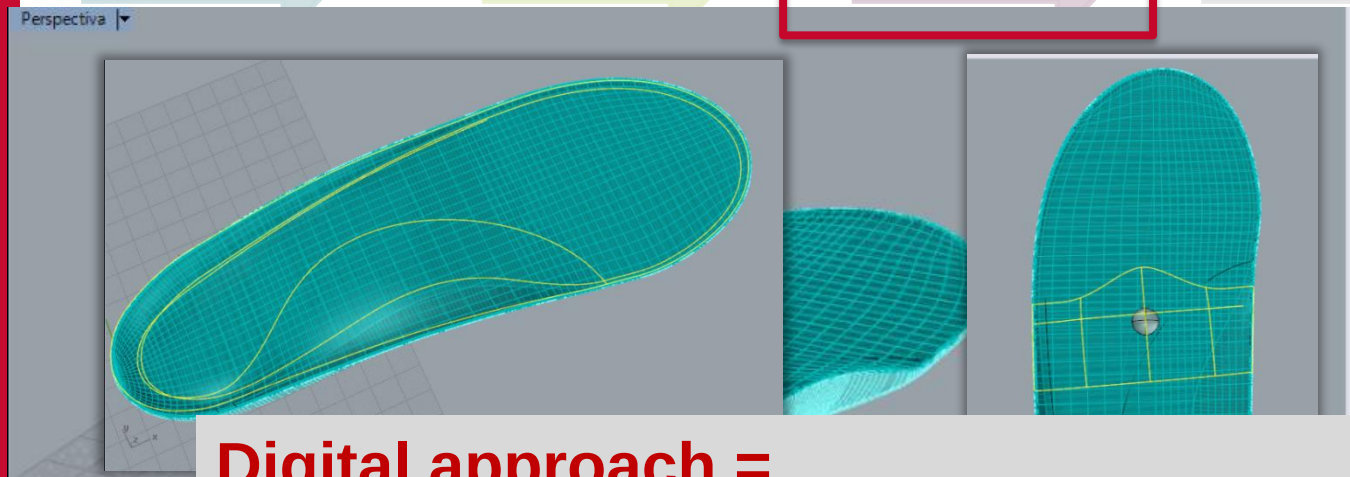
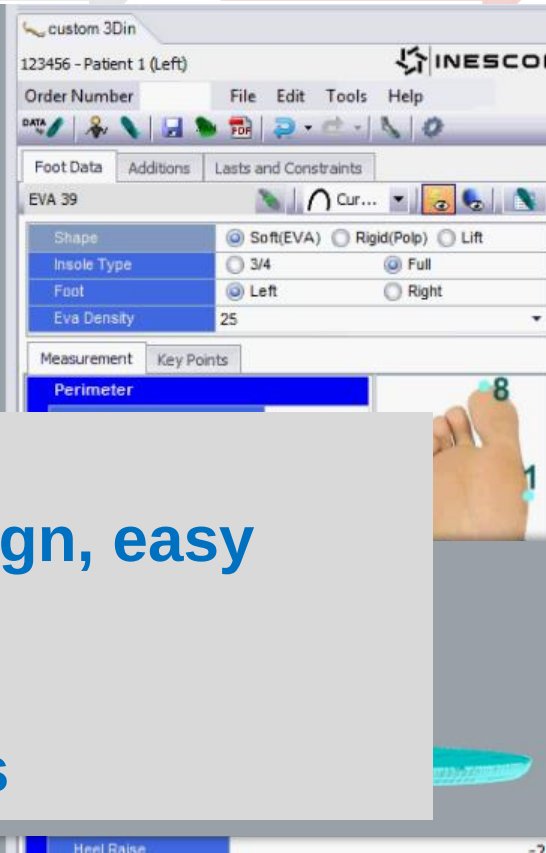
DIGITAL supply chain

1	2	3	4	5
Prescription	Supply Data	Design FO	Make FO	Supply FO
•Diagnosis •Define FO shape •Choose materials	•Foot shape •Photo •Other….	•Geometry •Materials	•Workflow •Quality	•To clinician •To patient





Digital approach =

1. Permanent record of orthotic design, easy repeat prescriptions
2. Enhanced pressure relief
3. Evidence base to orthotic designs

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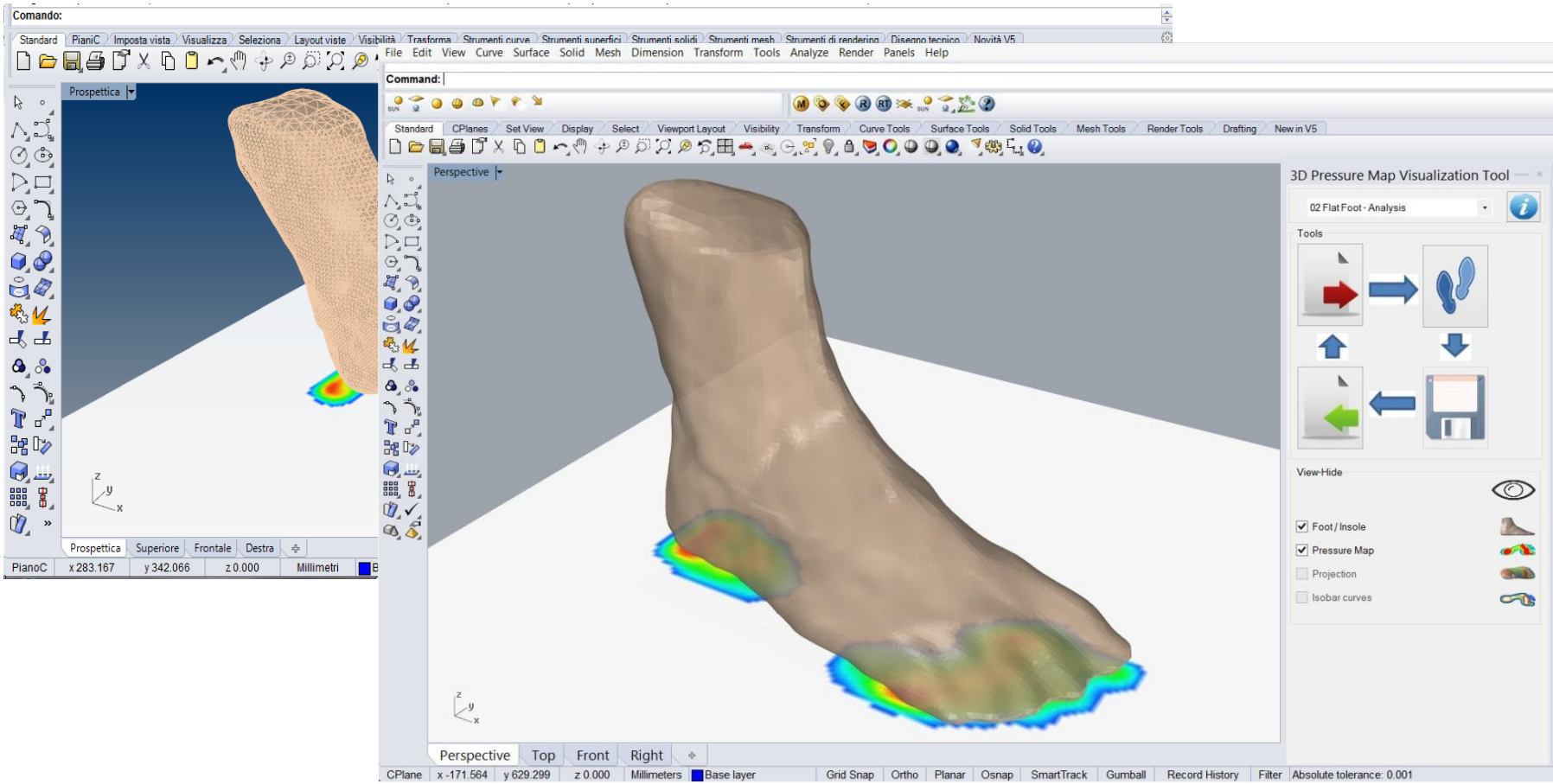

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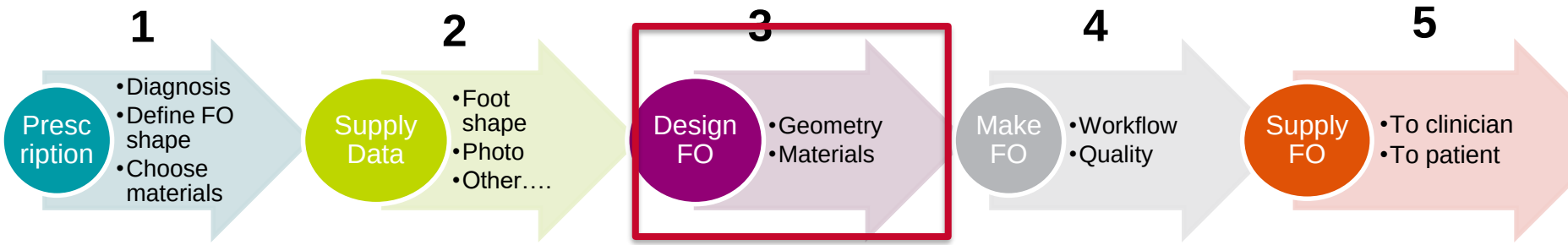
DIGITAL supply chain



Simulation tools

- ✓ Guide selection of materials ★
- ✓ Allow more sensitive range of materials
- ✓ Guide selection of geometries

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DIGITAL supply chain

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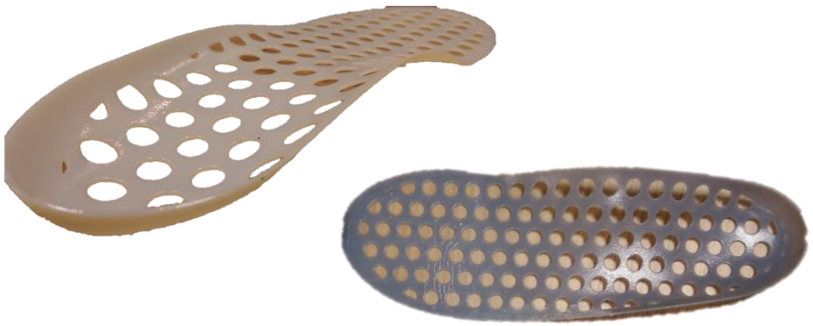
3D printing - approaches

1. Fusion Deposition Modelling (FDM)
2. Steriolithograthy (SLA)
3. Selective Laser Sinthering (SLS)
4. PolyJet
5. Continuous Liquid Interface Production (CLIP)



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3D printing

Opportunity:

1. Will introduce new materials to orthotics (from other sectors)

2. New material properties incorporated (e.g sensing properties, actuators).

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3D printing

Challenges

1. Current material ranges narrow
2. Still requires finishing
3. Current reliance on 3D printed + traditional materials together
4. Current devices are very similar **functionally to traditional orthotics** (or innovation minor), at many multiples of the price, with disadvantages.

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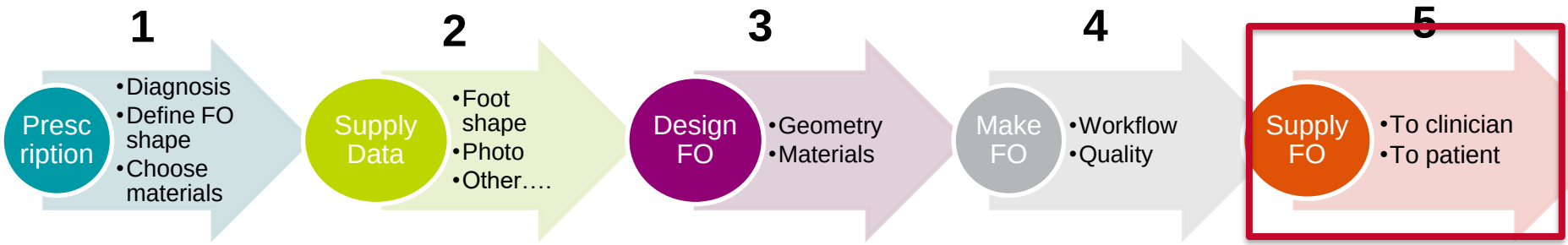

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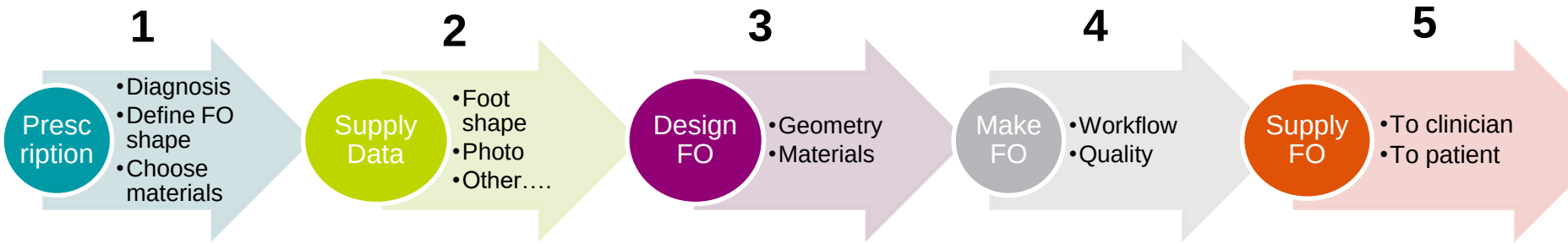
Does Digital = Custom Orthoses?



- ✓ Data on what is done, to whom, and what the result is, must be central to understanding practice and service and improvements.
- ✓ Providing data where there is currently none, or better data than we currently have, allows all aspects of practice to be studied, reviewed, improved and managed

Digital ORTHOTICS
Or
Digital WORK PRACTICES?

Digital Supply Chain -Summary

Opportunities:

- ✓ Lots of technologies being developed
- ✓ Not all expensive
- ✓ All stages of orthotic supply chain/services can be technology enhanced **– foot data – prescriptions – orthotic design – orthotic manufacture (& orthotic supply?)**

Challenges:

- ✓ High expectations driven by consumer products
- ✓ Prior –ve experiences of technology in practice
- ✓ Poor evidence of clear "**value added**"

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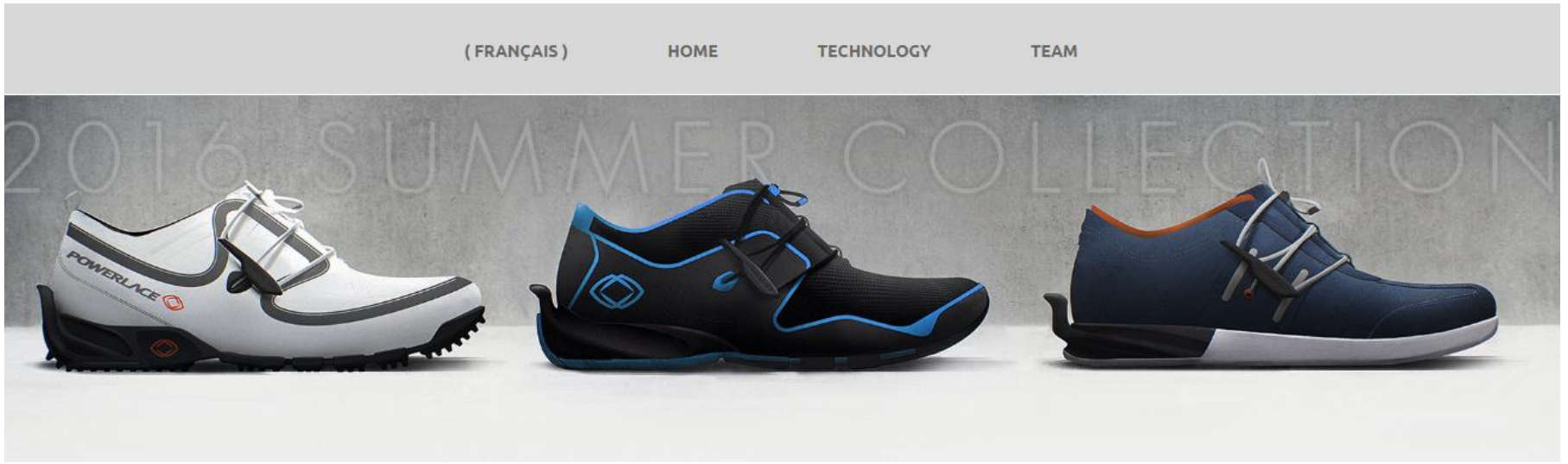
Dynamic/personalised SHOE Geometry

POWERLACE
ADVANCED LACING TECHNOLOGY



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PU and thermoplastic polyurethane (TPU) **for use in very cold weather conditions,** (BASF)

Combination of flex performance at extremely low temperatures

+

very high slip resistance on wet and icy surfaces,

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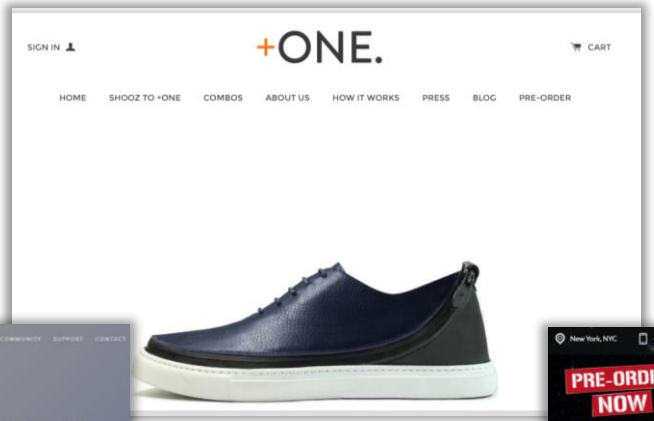
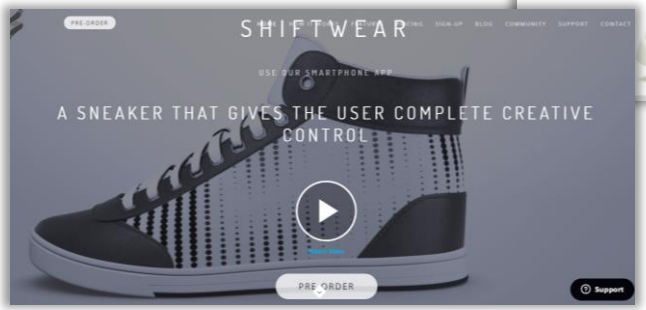
Consumer experiences

Experiences *Expectations* *Assumptions* *Understanding*





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TACK!

Professor Chris Nester
School of Health Sciences,
University of Salford

https://twitter.com/ProfChrisNester

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