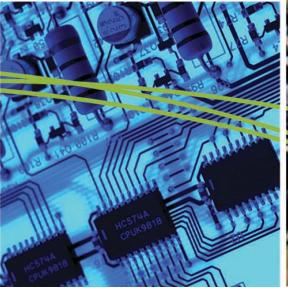
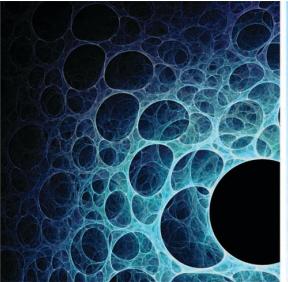




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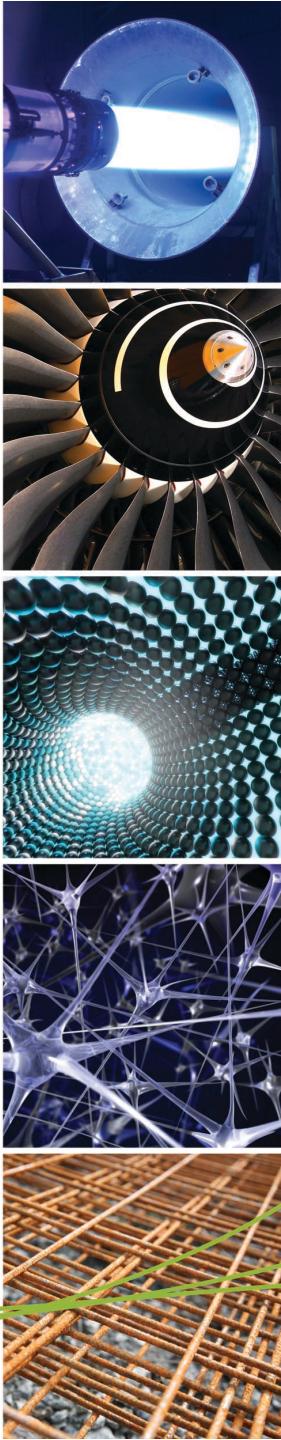
College of Engineering

www.swansea.ac.uk/engineering





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Interactive Glyph-Based Visualization for Real-Time Sports Performance Analysis

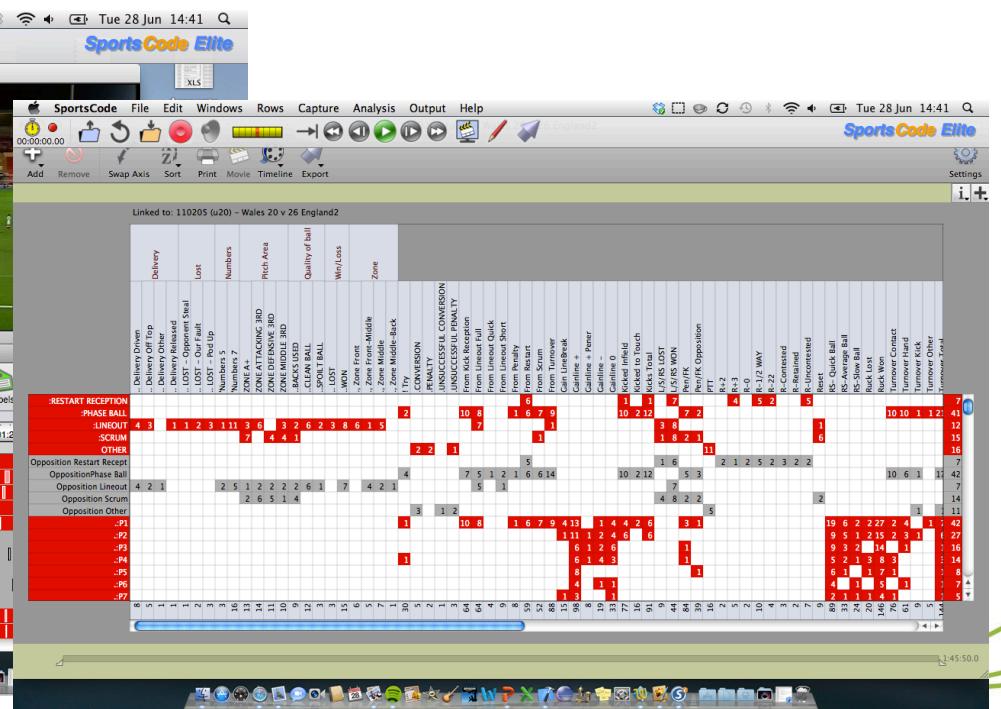
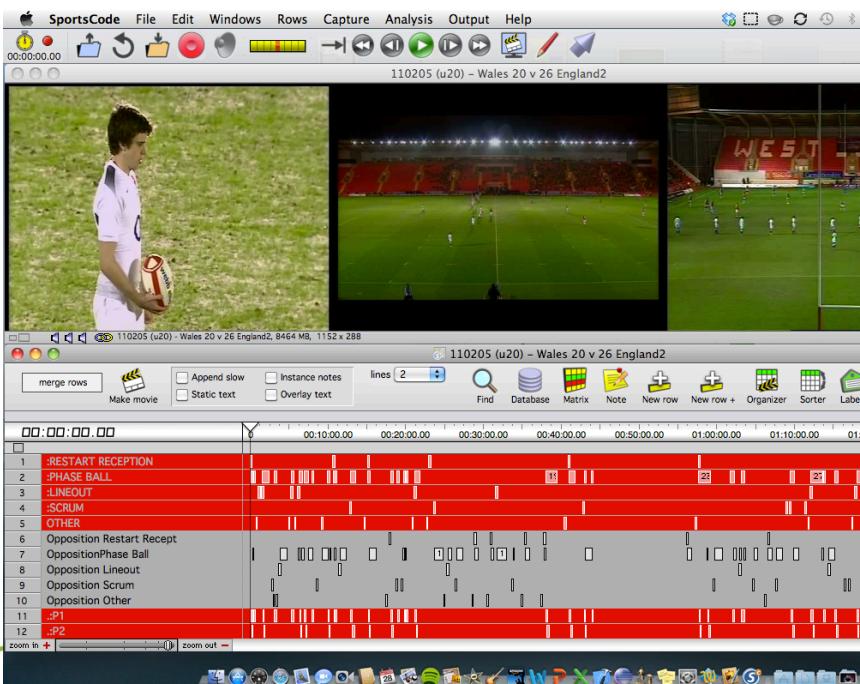
Dr. Philip A. Legg

Swansea University

April 2012

Problem

- Notational Analysis is used to collect data on the match.
 - Events, players involved, outcomes, techniques, etc...
- Results in “information overload” – difficult to quickly review.



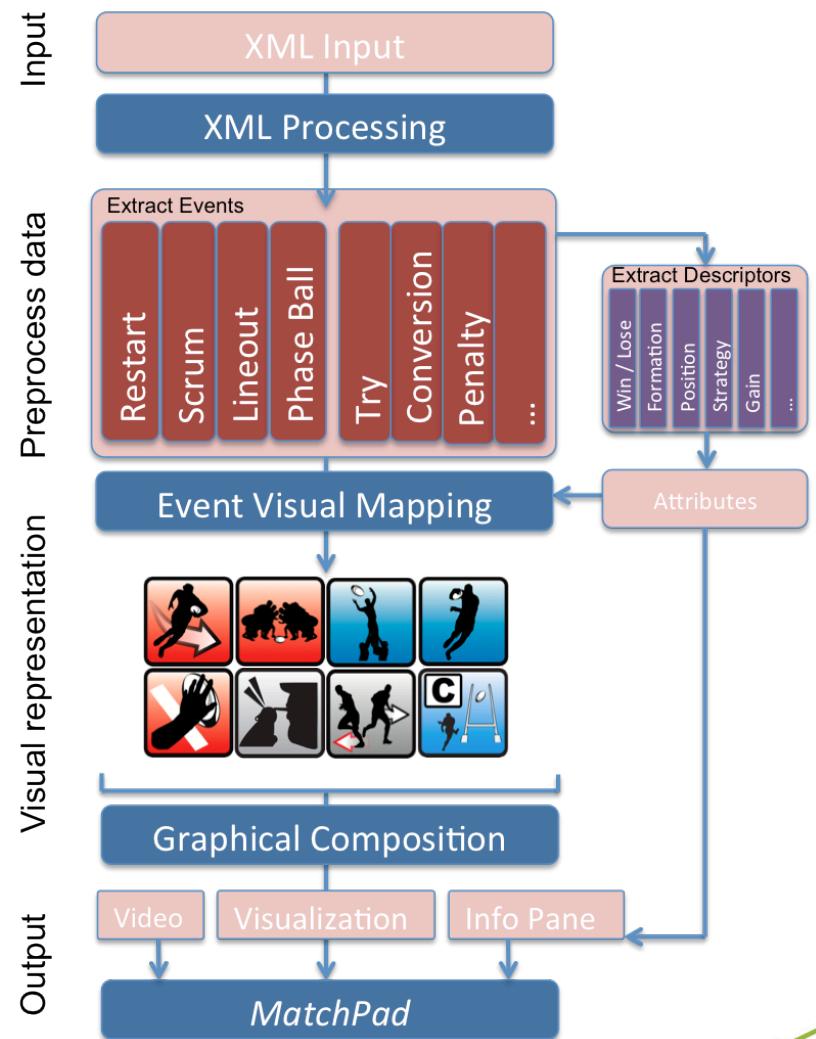


Question

- Can Visualization improve sports performance analysis?
- The visualization would need to:
 - Depict most, if not all, annotated events.
 - Link each event to the corresponding video for in-depth review.
 - Facilitate rapid information seeking and in-match decision making.
 - Serve as a visual aid for post-match team and player briefings.
 - Be intuitive, requiring minimal learning and memorization.
 - Operate on portable devices for pitch-side use during matches.

MatchPad Framework

- Four key stages that make up the MatchPad:
 - XML processing.
 - Event Visual Mapping.
 - Graphical Composition.
 - UI Integration.
- Pipeline is constantly repeated to collect real-time match data.





XML Processing

- XML is retrieved from the analyst's workstation at set intervals (e.g., every 15 second).
- The XML contains all recorded match events (up to current play).
- ID, Start / End Time, Event Type, Event Descriptors.
- The pipeline is designed to recognise the semantic textual codes specified in a dictionary for a particular sport or application.

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<end>106.1200</end>
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<text>ZONE ATTACKING 3RD</text>
<text>L/S/RS WON</text>
<text>From Lineout Full</text>
<text>..CLEAN BALL</text>
<text>.. Delivery Off Top</text>
</instance>
...
<instance>
<ID>46</ID>
<start>163.1500</start>
<end>176.1500</end>
<code>Opposition Scrum</code>
<text>L/S/RS WON</text>
<text>Pen/FK Opposition</text>
<text>ZONE DEFENSIVE 3RD</text>
</instance>
...
</ALL_INSTANCES>
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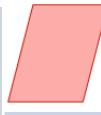
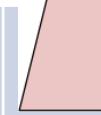
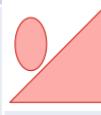
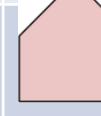
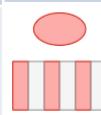
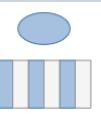
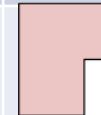
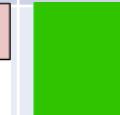
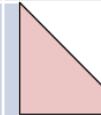
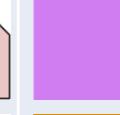
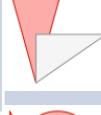
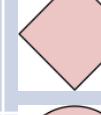


Glyph-Based Visual Mapping

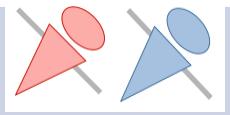
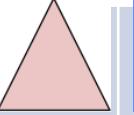
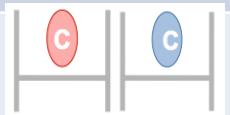
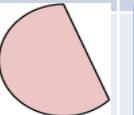
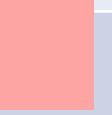
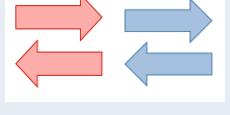
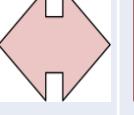
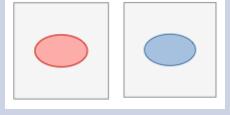
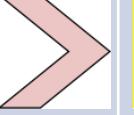
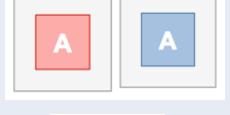
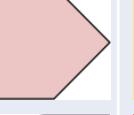
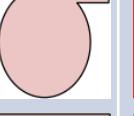
- Glyphs are used to depict multivariate data entries.
- Each glyph is composed of a number of visual channels, each of which encodes a specific attribute of the data.
- To fully appreciate the problem, we must first consider the full extent of the data space.



Rugby Data Space (1)

	Match	Team	Player	Outcome	Values	Metaphoric Glyph	Abstract Icon	Shape	Colour
Restart		○		Occurrence		 	 		
Drop Kick		○	○	Occurrence		 	 		
Scrum		○		Won/Lost		 	 		
Lineout		○		Won/Lost		 	 		
Ruck		○		Won/Lost		 	 		
Maul		○		Won/Lost		 	 		
Tackle		○	○	Won/Lost		 	 		
Pass		○	○	Won/Lost		 	 		

Rugby Data Space (2)

	Match	Team	Player	Outcome	Values	Metaphoric Glyph	Abstract Icon	Shape	Colour
Try	o	o	o	Occurrence					
Goal Kick	o	o	o	Score/Miss	C, P, D	 			
Injury	o	o	o	Occurrence					
Substitute	o	o	o	Occurrence					
Phase Ball	o	o		Occurrence	1 - 10				
Territory	o	o		Occurrence	A - D				
Referee	o			Occurrence	N, Y, R				
Ball in Play	o			Occurrence					



Design Options

- We consider four design options to represent events:
 - Metaphoric Glyph, Abstract Icon, Shape and Colour.
- Shape and Colour fail due to the large number of events.
- To meet our requirements, event depiction should be easy to learn, memorize and recognize.
- Abstract Icon although better, still requires some learning.
- Metaphoric Glyph is easy to recognize, especially for a domain expert, and requires no learning.

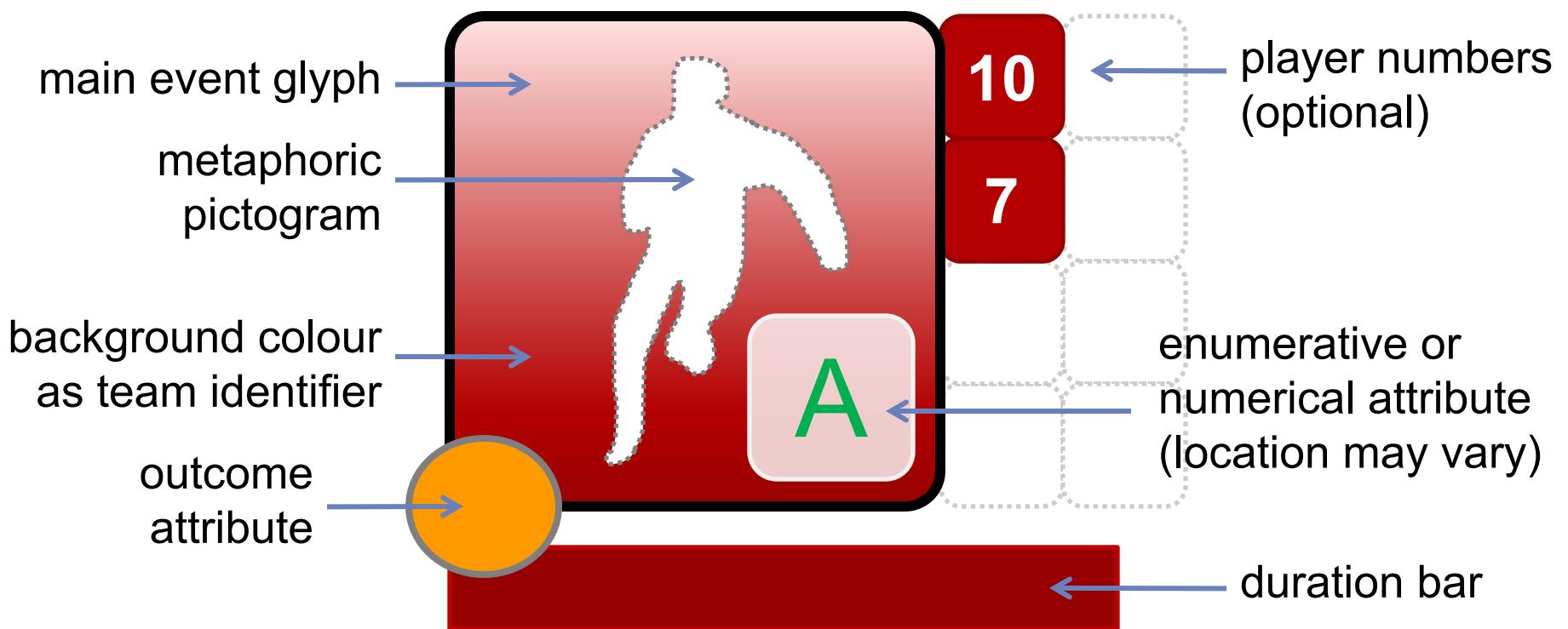


Metaphoric Pictogram

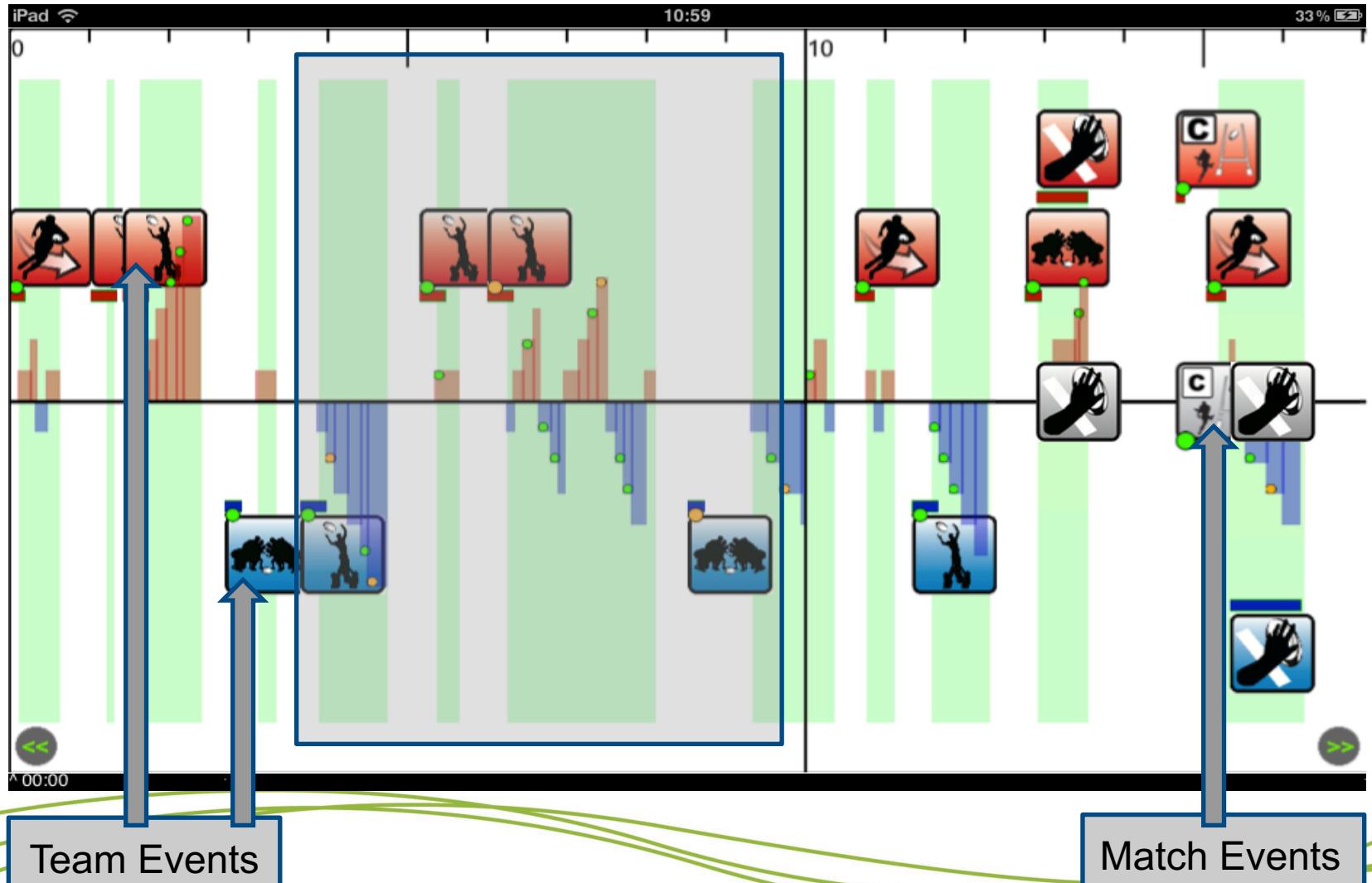
- Metaphoric Glyphs can come in different forms, ranging from abstract representation to photographic icons.
 - Abstract representation – requires learning.
 - Photographic icon – would restrict use of colour channel, distracting, and possibly confusing
- We consider metaphoric designs that lie between these two schemes.



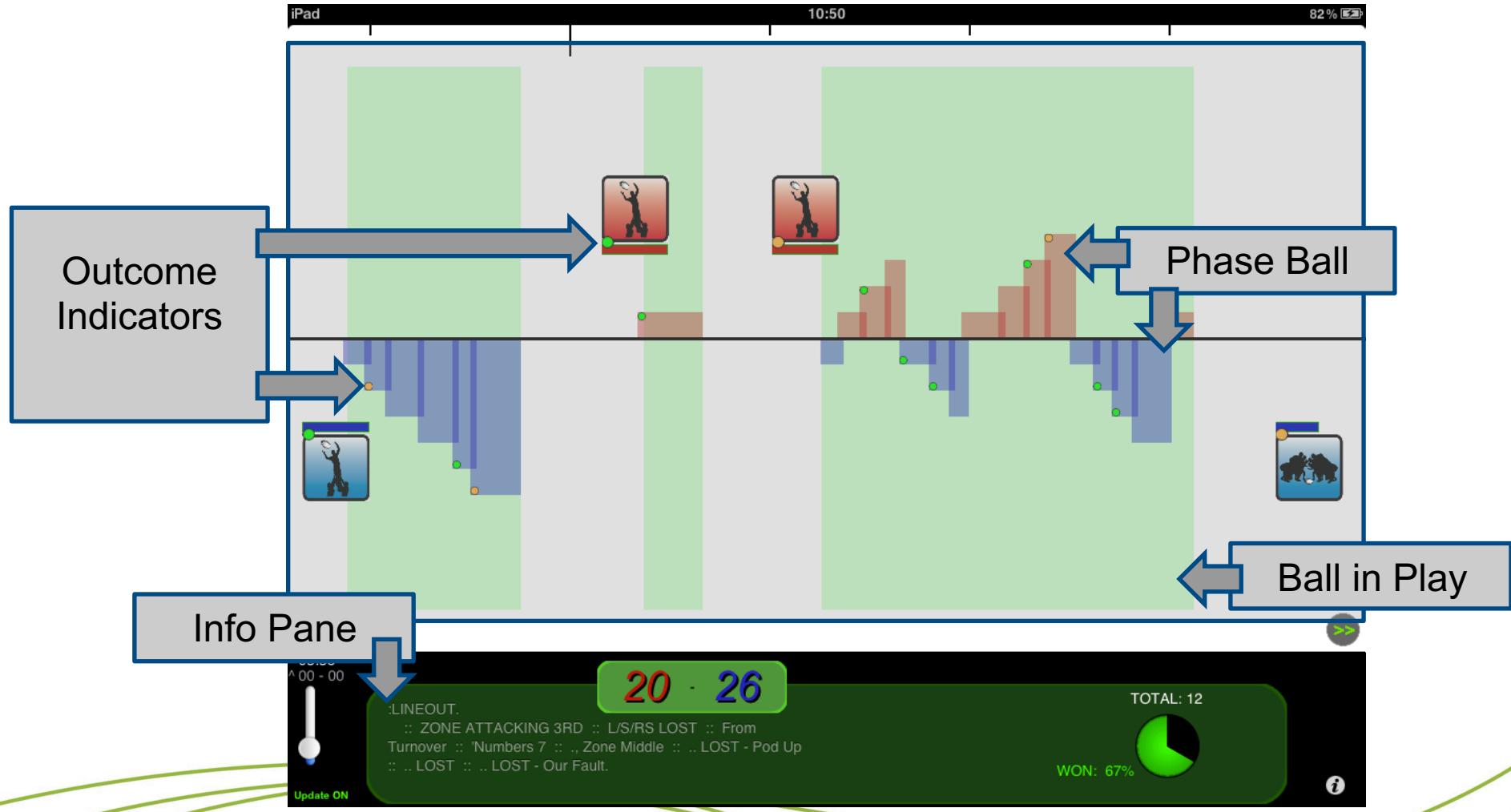
Resultant Glyph Design



MatchPad Interface



MatchPad Interface



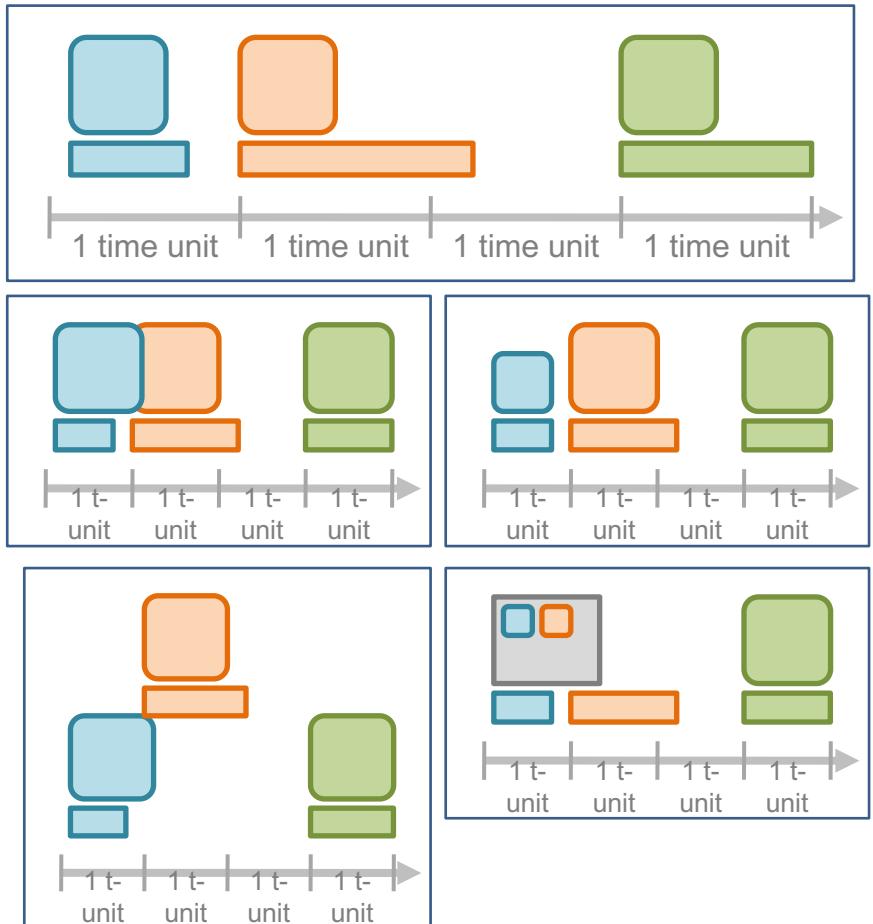


Visualization Interaction

- One of our initial requirements is to support rapid information seeking.
- To support this, we need a fast layout algorithm to respond to user's interactions.
- We utilize intuitive tablet gestures including swiping, pinch-to-zoom, and multi-tap, combined with a scale-adaptive layout to avoid glyph occlusions.

Scale-Adaptive Layout

- As the timeline is condensed, glyphs may become occluded.
- Four layouts are considered in a deterministic approach:
 - Horizontal stacking
 - Size reduction
 - Vertical stacking
 - Macro glyph





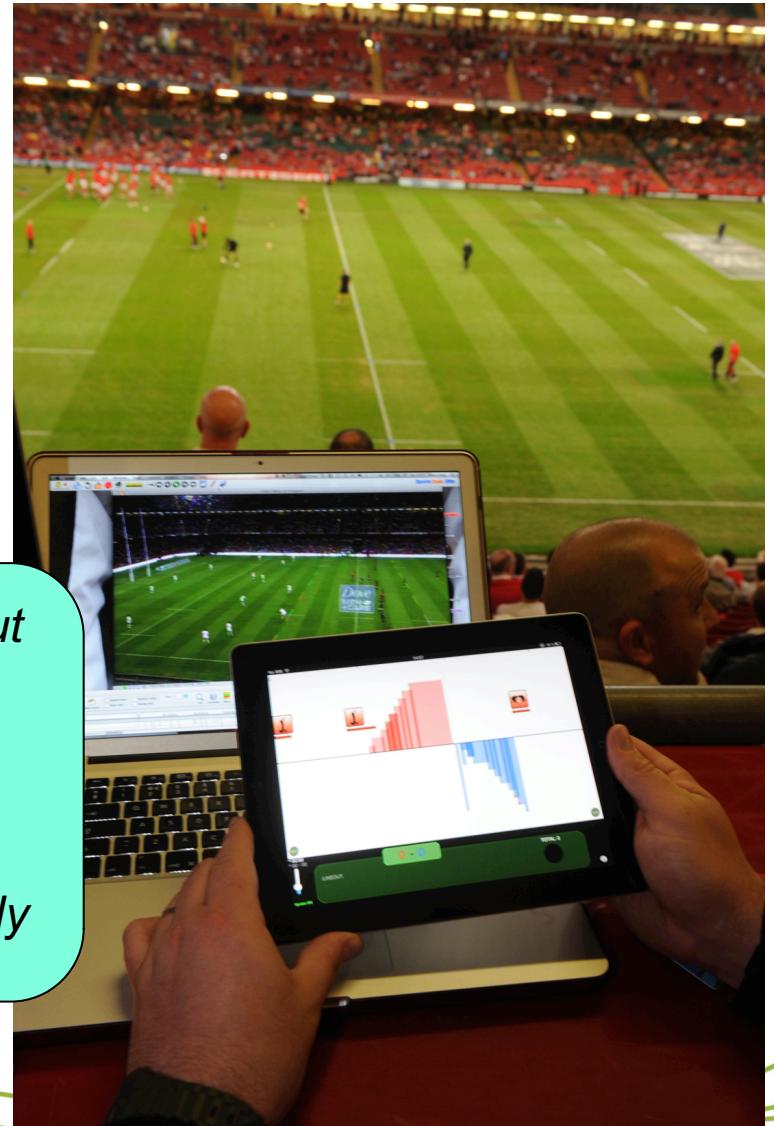
Evaluation – Welsh Rugby Union

It is a great tool for oversight when matches are very intense, to see what are the key events and how they interact with each other.



The main thing for us is visualizing the data and visualizing it in a very easy to interpret manner.

With the iPad it is about portability. We have it with us all the time so when the coach wants to know something we can show it immediately on the MatchPad.





Evaluation – Sports Science



*Greater visual clarity,
and more suitable for
rapid in-match decision
making.*

*Metaphoric glyphs
intuitive to interpret...
other approaches would
require learning and
could be misunderstood.*

*Spatial positioning and
'off-ball' positioning could
also be displayed.*

*How often is a player
involved – quick indicator
of player fatigue.*

*Live possession statistics
would also be beneficial.*

Expansion to Other Sports

- Working with Barnsley FC to adapt the MatchPad for other sports.
- Simply requires replacement of the “event dictionary”.
- Looking to introduce additional features such as live possession from notational analysis.





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SportsViz MatchPad Video



Thank you for listening.

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