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## Human Intelligence And Effectiveness Of Forensic Analysis

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**Abstract:** Human examination of security elements involves a recurring process: creating and implementing a plan and then monitoring and assessing outcomes. These steps try to determine the authenticity of the thing. These activities necessitate knowledge stored either internally (memorized) or externally (supplied by the object). Some claim that the world's knowledge is best suited for thorough examination of primary security elements. Knowledge stored in the mind is not dependable without consistent standardization. Five relevant questions arise from the action cycle. a) How readily can the user discern and comprehend the device's function? b) What actions can be taken? c) Perform the actions? d) Should we examine the outcomes? e) Compare the actual results with the anticipated results. Generic design guidelines are established based on the device's function, strategy implementation, and result assessment. Several initial security aspects are assessed from a human factors perspective. The features include substrate embedded elements such as watermarks and windowed threads, ink additives like iridescent pigments, printed characteristics like intaglio and tiny letters, see-through devices, latent pictures, and post-printed features like iridescent foils. Many current security features are found to not adhere to fundamental ergonomic design principles. Iridescent optically variable devices can meet these needs.

**Index Terms-** Security Document, Inspection lineup, Security authentication devices, Security feature's Design, Ergonomics for Design

### I. INTRODUCTION

The efficiency of a security system is significantly influenced by the proper, scientific, and thorough assessment of security elements for secure documentation and circulation. The inspection procedure is categorized into three distinct classes:

- a) **FIRST LINE INSPECTION.** Initial inspections are conducted without supplementary equipment, typically by members of the public. Common initial security measures include watermarks, intaglio printing, security threads, holograms, optically changeable ink, and registered printing. It should enable the detection of the majority of forgeries that utilize public security features. Color plays a significant role in the initial security evaluation of papers and products. The colors of the printed pattern are selected to prevent accurate reproduction using color copiers and desktop systems. Color communicates information to the viewer regarding significance and genuineness.
- b) **SECOND LINE INSPECTION** - During the second line examination, trained inspectors like bank tellers and cashiers use instruments to check the document. Second-line security elements such as magnetic inks, barcodes, and money changing devices are also used for second-line checks. During a

secondary inspection, the employment of basic tools helps verify the genuineness of a document. Equipment may consist of a magnifying glass, UV sources, and a white light beam. The software also includes instruments for automatically detecting counterfeit or fabricated documents, which can range from complex to relatively basic, such as a Card Authentication Method (CAM) reading device.

- c) **THIRD LINE INSPECTION:** The third line inspection entails investigations conducted by forensic professionals using advanced equipment, typically in a laboratory or specialized inspection facility. This examination utilizes specialist equipment like spectrophotometer, microscope, infrared cameras, and chemical markers to verify suspected counterfeits or forgeries. These inquiries can be harmful.

First-line security device inspection relies solely on human senses, excluding the use of instruments such as magnifiers, UV sources, retro viewers, bar code scanners, etc. These are the characteristics of public security. The security device functions as a black box that requires operation by a human inspector. Figure illustrates the transformation of an operand (matter, energy, information) from its current state to the desired state using the black box. The operator uses the black box to convert information about the desired action and its anticipated outcome into feedback regarding the authenticity of the black box, achieved through verification and falsification.

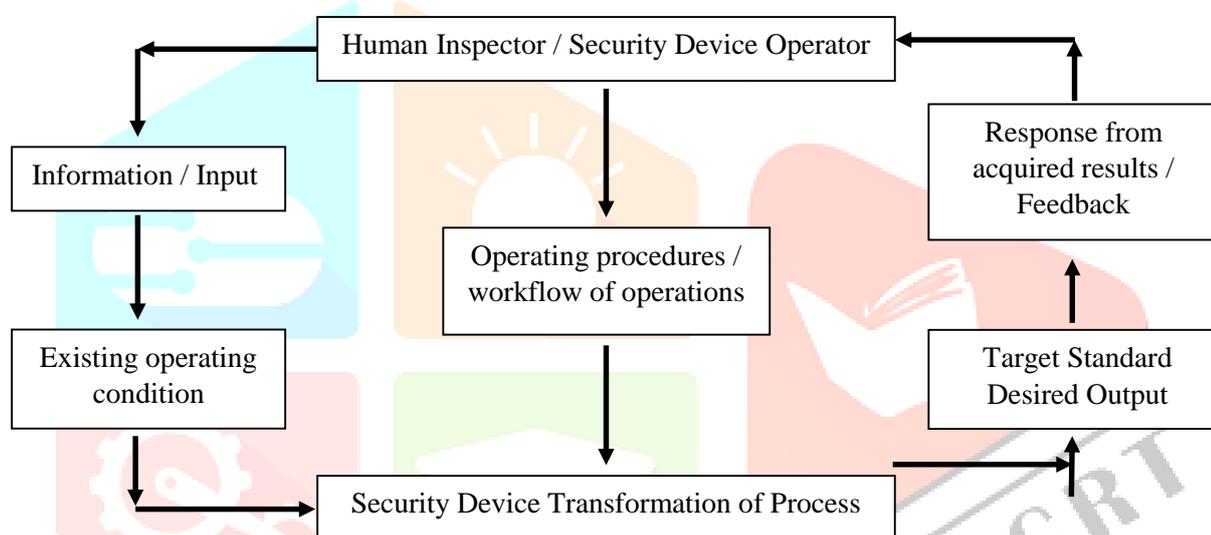


Fig – 1 Model for Device Based Security Inspection

Both confirming and falsifying necessitate an interaction between the operator and the security equipment, assuming prior knowledge or information. Industrial designer Donald Norman distinguishes between knowledge that is internalized by the operator and knowledge that is externalized in the environment.<sup>4</sup> The first sort of information is operator-known *a priori*, while the second type is security feature-provided without requiring prior operator knowledge. Information stored in the mind has been sent through several modes of communication, such as spoken or written, and then committed to memory. Typically, users of security devices heavily rely on their own knowledge for thorough inspection, as the security device often lacks the necessary information. Producers of security documents like banknotes and checks aim to inform users about the security features in place and how to authenticate or detect counterfeits. Detailed booklets and posters are distributed, and TV commercials are aired to achieve this goal. Brochures and manuals are designed to convey information to the mind, not to create new information. This method has shown to be generally ineffective since users are not retaining the information they are expected to remember. This could be attributed to the wide range of important papers and security features present, together with the absence of uniformity both inside and outside categories of valuable documents. The user's task of memorizing a large amount of information seems unfeasible. The challenge is in creating highly secure gadgets that are extremely difficult, if not impossible, to counterfeit. The issue lies in creating security gadgets that are easy to inspect yet inspire great confidence in their authenticity.

## II. AFFECTING FACTORS

Donald Norman's research model help to go deeper into the interaction between the examiner (subject) and the security device (object), we will investigate the action cycle shown in figure 2. This process cycle is analogous to model of figure 1. The action cycle consists of two stages:

- (1) Formulating and Implementing a strategy as input,
- (2) Assessing and Analyzing the outcome / output.

This process is linked to the overarching principles of industrial product design and serves as a valuable framework for creating secure designs. When operating a security device, the examiner will create and implement a strategy to effectively utilize the equipment. The outcome of this activity will be assessed based on observations, leading to a conclusion regarding the device's status. To operate the security equipment effectively, the user must possess sufficient understanding of its functionality to avoid errors in operation or judgment. Inadequate information can lead to repeatedly going through the action cycle multiple times, potentially without reaching a definitive outcome. If ignorance is at its worst, the specific security function will not be used. The action cycle structure poses five essential questions about the effectiveness of security systems in terms of human factors design (ergonomics).

### The Ease of Examiner to :

1. Identify and comprehend the device's capabilities?
2. Please specify the necessary actions ?
3. Conduct the operation ?
4. Take note of the outcome ?
5. Draw the appropriate conclusion by comparing the observed results to the anticipated result ?

## III. GUIDELINES WERE CREATED TO ADDRESS HUMAN FACTORS IN DESIGNING SECURITY ELEMENTS ON :

### Functions –

- a) The security feature should communicate a message that is pertinent to the product.
- b) The feature should be appropriately positioned and relevant to the product. The security characteristics of connected items must be interrelated.
- c) Security features should ideally be situated in standardized positions on the product, positions designated specifically for security features across all products in the range.
- d) The feature's function must be clear and understandable. If a feature is puzzling to the user, it is not working. The device's intended use should be clear beyond just enhancing the product's appearance.
- e) The functions need to be standardized. Complex security designs that are diverse and frequently alter layout may not be easily understood.

### Execution -

- a) It should be clear what to look for and how to inspect it, ideally without the need for prior verbal or written instructions.
- b) The details of the "what" and "how" of the feature should ideally be present in the document. The "what" and "how" of doing the inspection should be easily communicable and memorable, even if outside the world. Standardization is an excellent method for achieving this goal.
- c) The inspection should be conducted in a casual and inconspicuous manner. Even a modestly intricate inspection will be deemed bothersome. The act's obviousness could be seen embarrassing and unpleasant. The inspection is unlikely to be conducted for these reasons.

## Evaluation Criteria -

- a) Effects must be easily observable, and information should ideally be readily available. If the knowledge is not readily available, it should be easily communicable and memorable.
- b) The description should clearly and distinctly convey the exact impacts without being vague, even though it is concise.
- c) The observed impacts must clearly correspond to the anticipated results. Ambiguous signals will lead to doubt.
- d) The security feature should clearly correspond to the overall design.
- e) The feature must be appropriately positioned. Variable add-ons provide insufficient or perplexing information.
- f) The security features should be unique and not have any competitors that may be successfully imitated.

## IV. AFFECTED FEATURES OF SECURITY DOCUMENT

Attempting to answer fundamental questions regarding common security features such as mould made watermarks, windowed threads, see-through devices, intaglio printing, small lettering, and iridescent optically variable devices (OVDs) can provide valuable insights. The effectiveness of these security elements in preventing counterfeiting will be discussed in a separate study. The examiner will not be able to compare the security devices being evaluated with other devices, as is typically the situation. Referred to as authentic; the examination being discussed is of the utmost kind. An examiner must pay appropriate attention for a security design to effectively fulfill its role, regardless of its ergonomic adequacy. Nonchalant or indifferent handling of banknotes will not expose counterfeits. The quantity of counterfeit items in circulation is not a sufficient indicator of the effectiveness of a security design. This figure is also influenced by several factors, such as the attractiveness of the currency to counterfeiters and the level of public information available.

- **Watermark** - The cylinder mould watermark appears on a wide range of banknotes and other security documents globally. This security feature has a long history, dating back to the production of handmade papers in Italy in the late thirteenth century.<sup>10</sup> It has now become a standard due to its widespread use. Papermakers consider it the primary and most secure feature, serving as a key deterrent against counterfeiting.
  1. *How simple is it for the examiner to identify and comprehend the function of the device?*
    - Typically, the watermark is not easily visible to the naked eye. It's crucial for the examiner to be aware of its presence, which is typically found on numerous banknotes in an unprinted section. It is widely understood why watermarks are used: to authenticate or invalidate a document by checking for its presence and specific features under transmitted light.
  2. *How clear is it for the examiner to determine the necessary actions?*
    - Hold the paper up to the light and check for the image shining through. This process may not be obvious, but due to standardization, it is widely recognized by the public. The watermark's location is typically identified by the blank space on the note. Afterward, look for consistent tone, as well as variations in light and dark areas of the image. These features are commonly found in the mould made watermark, but are often overlooked by the general public and not explicitly disclosed by the watermark.
  3. *How user-friendly are the actions for the examiner to perform?*
    - Physically, this action is straightforward, but it comes with a significant psychological downside: the potential for embarrassment.<sup>3</sup> It seems that most people are hesitant to carefully examine a banknote upon first seeing it, increasing the likelihood of only a quick inspection.
  4. *How visible are the results to the examiner?*
    - Understanding the features of the mould made watermark can be intricate, necessitating careful observation and expertise. When properly designed, a mould made watermark enables easy identification of its distinct features. Yet, some bank note watermarks may not clearly show light and dark image

elements, making it difficult to observe.<sup>3</sup> Moreover, in numerous instances, watermarks showcase portraits that do not effectively blend these features in an ergonomic way, making their easy examination quite challenging.

*5. How simple is it for the examiner to compare the observed results with the expected results and make accurate conclusions?*

- It is usually unclear what the expected results of the typical mould made watermark characteristics are and the device does not provide this information. Thus, it is generally not feasible to adequately compare the observed results with these characteristics. Furthermore, even with a well-designed device and an examiner who is well-versed in those features, it is important to be attentive when checking for them.

The importance of the watermark for public examination relies solely on its standardization. The effectiveness and simplicity of its inspection are often hindered by lack of public awareness, psychological barriers, and sometimes by inadequate design and execution. It's difficult to argue that the watermark is a significant obstacle to counterfeiting.

- **Window Thread** - This windowed security thread is a development of Portals (UK) and is applied to bank notes as a security feature on notes from countries like the UK, Germany, Switzerland, and the Czech Republic. This is not a typical security feature. The thread in the window has a shiny appearance, appearing and disappearing on the paper's surface in a repeating pattern of approximately 10 mm. Due to this, unlike its predecessor the fully paper embedded security thread, the windowed thread is partially visible during regular observation. When transmitted, the thread is seen as a seamless ribbon. Usually, the thread comes with small lettering that can be seen in reflection and transmission.

*1. How simple is it for the examiner to identify and comprehend the purpose of the device?*

- It is essential to regularly inspect the windowed thread for security purposes during observation and transmission. The first line inspection function involves confirming or denying the document by checking for its presence and various characteristics. These traits are straightforward yet varied. The purpose of the windowed thread function may not be immediately clear, and due to the device's non-standard nature, its complete functionality will likely remain mostly undisclosed. The necessary information is not readily available.

*2. How clear is it for the examiner to determine the necessary actions?*

- There are four necessary actions. When inspecting, look for a ribbon that is interrupted and has a metallic reflection, showing clear small lettering. When checking for transmission, ensure that there is a consistent ribbon with clear small lettering running along its entire length. Without a clear understanding of the device's function, the examiner will struggle to identify the specific characteristics to examine without prior knowledge.

*3. How simple is it for the examiner to perform the actions?*

- This quadruple process is quite intricate. Examining the reflectivity of metal is typically quick and straightforward, but assessing small text legibility demands careful attention and sharp vision. Carrying out this task can be a bit inconvenient and time-consuming. Further examination of the transmission involves dealing with potential embarrassment and dedicating more attention to inspecting small details.

*4. How visible are the results to the examiner?*

- Examining the reflection of metal under regular lighting and ensuring its consistency when viewed through is a simple and uncomplicated task. Evaluating the clarity and readability of small text can be subjective since sharpness levels can differ even when the text is still readable. Thoroughly examining sharpness may pose a challenge.

*5. How effectively can the examiner compare the observed results with the expected results, and draw accurate conclusions?*

- The reflective nature and seamless flow of the thread make it simple to compare with the anticipated outcome. Comparing the observed lettering quality with the expected quality can be challenging, especially when trying to recall past experiences.

Understanding the windowed thread can be complex since it is not a standard feature with a straightforward purpose. Thorough examination, including small lettering, can be challenging, time-consuming, and may cause psychological barriers.

- **The See Through Device** - Accurately aligning the printing on both sides of a document enables the creation of a see-through device. It includes corresponding image components on either side of the document. When held up to the light, you can see the alignment of the front and back image components. This transparent feature is commonly found on banknotes and is considered a standard practice. Not all bank note printers can accurately align the front and back images of the document.

*1. How simple is it for the examiner to identify and comprehend the function of the device?*

-When looking at the see-through image, only half of it is visible, and this half needs to show the device's function. The front and back elements usually include complete, abstract geometrical shapes as seen in the 100 / 500 Rs note . These solid shapes do not provide the examiner with any practical information to verify or authenticate the document by examining its front-to-back alignment. The examiner needs to already know about its existence, which is usually not the case, despite the widespread use of the see-through device. The necessary expertise is not readily available. The new bank notes feature a see-through device that shows an incomplete image of well-identifiable objects like a mouse or a tulip. When held against the light, the full image is revealed with all four quadrants visible. It's interesting how the knowledge is subtly presented in the world: the incomplete image encourages users to explore the device's function without any preconceived notions. This configuration of the transparent display is ideal for standardization purposes. Yet, these devices are not easily recognizable as security features, nor is their placement on the note readily apparent. Accomplishing this involves placing standard security features in specific locations designated for security features on all banknotes. Given that documents can be examined against the light for the watermark, one potential option is to merge the see-through feature with the watermark. Implemented on the latest Swiss banknote series. It's interesting that Swiss brochures discussing the authenticity tests of their new currency design don't mention the watermark or see-through device. It seems that issuers do not view public inspection in transmission as a feasible option.

*2. How clear is it for the examiner to determine the necessary actions?*

-Hold the paper up to the light and check for the watermark. Making this action more clear is achievable through proper design and standardization. Next, verify the front-back alignment. A well-designed device will clearly show its characteristic front-back register.

*3. How simple is it for the examiner to perform the actions?*

-Examining the transparent register against the light may seem straightforward physically, but the psychological discomfort it can cause adds a unique challenge.

*4. How visible are the results to the examiner?*

-When well designed, see-throughs enable a quick, simple, and clear check of front-back register. It's important to highlight that verifying register is typically simpler than examining more intricate features like watermarks and windowed-threads. It will be difficult to observe results if see-throughs contain abstract image elements that overlap in transmission, making it hard to see them as a whole. The front and back image elements overlap, making it difficult to inspect them properly as they block each other

*5. How simple is it for the examiner to compare the observed results with the expected results and make accurate conclusions?*

-When the see-through is well-crafted, it allows for easy verification of alignment between front and back image elements. Sensing register is not difficult. The transparent device is a valuable security tool that enables quick and easy inspection. Nevertheless, its public inspection value remains limited due to the lack of standardization and inadequate conveyance of its function in current designs. Moreover, thorough examination seems constrained by psychological limitations.

- **Intaglio Printing** - Intaglio printing is mainly utilized by security printers. Intaglio printing is commonly found on important documents globally and is viewed as a standard security element, similar to watermarks. Most security printers highly appreciate its characteristics. Intaglio printing is known for the unique tactile feel of the printed lines, which are raised on the paper, and the sharp look of the detailed engraved lines. Intaglio tactile experience In addition to other security features checked visually, intaglio printing allows for discreetly detecting the intaglio relief through touch. The paper shows relief deformations due to the high pressure used to transfer the gravure image. Intaglio relief gradually fades over time as the note ages. Otherwise, the initial recognition by the public may not be completely trustworthy.

*1. How simple is it for the examiner to identify and comprehend the purpose of the device?*

Examining intaglio's first line inspection function includes confirming or disproving the document by sensing its tactile relief. Intaglio printing is found on most banknotes, but its purpose may not be immediately clear and its design can vary. Otherwise, the use of intaglio for important documents seems to be decreasing. As a result, the general public is mostly unaware of this feature. The necessary expertise is not readily available. The new bank notes feature a prominent intaglio design with tactile elements on both the left and right sides of the note. When holding the note between thumbs and index fingers, the relief becomes apparent almost effortlessly. These intaglio elements have unique shapes for each denomination, designed for easy tactile inspection and to assist visually impaired individuals in recognizing the denomination. This design showcases a commendable effort to share information about the function of intaglio worldwide and simplify its inspection process. Furthermore, these patterns can be effectively standardized.

*2. How clear is it for the examiner to determine the necessary actions?*

Experience the tactile nature of the printed design. Meeting this requirement is not always obvious, but it can be achieved through thoughtful design, as seen on banknotes, and by following standardized practices. Typically, intaglio printing involves intricate lines that are not easily detectable by touch. One can experience the relief by gently scratching the printed line patterns with a fingernail, which also produces a sound. This inspection method is not widely recognized and remains largely unfamiliar.

*3. How simple is it for the examiner to perform the actions?*

Grasping the note between thumbs and index fingers allows for detecting the texture in a subtle and effortless way. Intaglio patterns are carefully crafted to facilitate subtle tactile inspection using the thumbtip. This action is straightforward. When paper embossing is done with enough force and bank notes are removed from circulation on time, the intaglio print on used bank notes will maintain a noticeable tactile feel.

*4. How visible are the results to the examiner?*

When the design and placement of the intaglio pattern are well-executed, its tactile nature can be easily and subtly felt. Most bank note designs require the examiner to search for a suitable location for intaglio inspection, without explicitly facilitating this observation. This makes it difficult to easily observe the tactile quality of intaglio.

*5. How effectively can the examiner compare the observed results with the expected results, and draw accurate conclusions?* The texture of the intaglio design differs among notes, based on their condition. Hence, the anticipated outcome should not be a specific level of tactile sensation, but rather any tactile sensation at all. Seems like a simple observation, but it can be unreliable with untrained inspectors.

Intaglio tactility is a valuable security feature that enables quick, inconspicuous inspection without triggering psychological barriers. Nevertheless, its public inspection value is restricted since most current designs do not effectively communicate its function, and the intaglio design is not standardized for tactile inspection.

- **Invisible image** - Various countries, including Austria, Germany, and Switzerland, use the latent image as a security feature on their banknotes. This feature is not standard and does not seem likely to become one. The hidden image remains unseen under normal observation but becomes apparent under near grazing incidence. The impact relies on the unique relief of intaglio printing. The optical effect has been demonstrated in a previous publication.

1. How simple is it for the examiner to identify and comprehend the purpose of the device?

- Examining a latent image includes checking the document for a light image on a dark background or vice versa, using grazing incidence. Noticing the hidden image provides compelling proof of the authenticity of intaglio. Because the latent image is invisible under normal observation, it does not give the examiner any clue of its existence, let alone of its function. The examiner must know the device is there and understand its function. This is generally not the case, because it is not a widely used feature. The required knowledge appears neither in the head nor in the world.

2. How easily can the examiner tell what actions are required?

- Observe the document under an oblique angle, so that the light source reflects in it and the surface becomes glossy, and look for the appearance of an otherwise invisible image. This action is not evident at all, and it is difficult to imagine a design to which this disadvantage is not adhered. Subsequently, rotate the document in its own plane about an angle of  $90^\circ$  & observe a contrast swap between foreground and background.

3. How easily can the examiner execute the actions?

- Even if having prior knowledge about the presence of the device, observing the gloss of the document under an oblique angle is a demanding action for unexperienced examiners. The action is further hampered if the direction of observation is not along the edges of the note but, for instance, under  $45^\circ$  with the edges, as is the case with bank notes. Subsequently observing the contrast swap by rotating the document in its own plane under near grazing incidence is time consuming and motorially demanding. Furthermore, this action is so obvious that is strongly associated with the embarrassment factor.

4. How easily can the examiner observe the results?

- If the latent image is well designed, its optical effect can be sufficiently obvious. As the effect must be observed under oblique observation, the surface of the document must be sufficiently smooth. Circulated bank notes that have become wrinkled do no longer allow adequate inspection of a latent image.

5. How easily can the examiner compare the observed results with the expected results, and draw correct conclusions?

- The latent image showcases a straightforward background-foreground image effect that can be easily compared with the anticipated outcome. The purpose of the latent image may not be immediately clear, and examining it is mainly possible on smooth paper surfaces, which can be physically demanding and mentally challenging. Furthermore, this feature is not a standard. Its sufficient and straightforward examination is therefore greatly hindered.

- **Engraved Portraits** - In the past, engraved portraits, especially of well-known individuals, have been used on bank notes as a security measure against counterfeiting. Engraved portraits are valued for their security due to the challenge of replicating them precisely. Identifying faces can be quite challenging due to the advanced human skill in facial recognition. Small discrepancies in a forged portrait engraving would likely stand out, even upon a quick glance. This method has been highly praised for its effective human factors design, leading to the widespread use of portraits on banknotes worldwide. Nevertheless, this method has become less significant with the emergence of modern photomechanical and digital reproduction techniques. Counterfeiters nowadays seldom use the intricate craft of engraving, opting instead for offset techniques and color copiers. Line offset reproductions and color copies of a gravure can be challenging to differentiate from the original, even upon close examination. Engraved portraits no longer hold the same security value they once did, but the tradition is still upheld despite the lack of a practical reason for it. There is no concrete evidence to support the use of engraved portraits as a security feature. It seems that the National Bank of the Netherlands has acknowledged this situation and is now producing currency of exceptional quality without featuring portraits.
- **Microscopic Text** - Small text, typically ranging from 0.5 mm to 0.8 mm in height, is commonly found on various banknotes, although it may not adhere to a universal standard. In the Netherlands, it is considered an official public security feature, even though it is not typically located in a standard place.

Under typical lighting conditions, small text is easily readable without the need for a magnifying glass. Text with a height between 0.15 and 0.5 mm is commonly referred to as microtext or microprinting, which is a secondary feature that needs a magnifying glass. Otherwise, characters with a size of 0.5 mm and above provide minimal security.

1. How simple is it for the examiner to identify and comprehend the function of the device?  
- Examining small text involves confirming the document's readability. Small lettering is typically subtle in the design, making it go unnoticed by the examiner. Otherwise, someone unfamiliar with the subject may struggle to locate it since it's not in a typical location. Expertise is not readily available. Once the small lettering is found in a clear and common location, and covers a substantial area, its purpose can be easily identified and comprehended. The device's content could effectively communicate the required information.

2. How clear is it for the examiner to determine the necessary actions?

- Locate a spot with tiny text. This request may not be clear, but with proper design and standardization, it can be clarified. Afterward, review the text to ensure it is clear and crisp. Most likely, the device will display this information, but for someone who can read, this step should be straightforward. Upon viewing the text, there is an almost instinctive urge to start reading it.

3. How simple is it for the examiner to perform the actions?

- Once properly designed and its location standardized, an area with small lettering can be easily found in regular observation. Examining tiny text and assessing its readability demands careful focus and keen eyesight. Carrying out this task can be a bit inconvenient and time-consuming.

4. How visible are the results to the examiner?

- Evaluating the clarity and readability of small text can be subjective since sharpness levels can differ significantly. Letters vary in sharpness, and even slightly unsharp text can still be readable. This task differs from setting front-back register, which can be either present or absent. In addition, the fine details of small text are at the limit of what the human eye can easily see, making it challenging to observe. Therefore, it will be quite challenging to observe the outcomes.

5. How effectively can the examiner compare the observed results with the expected results, and draw accurate conclusions?

- Examining the clarity of the lettering on its own can be challenging, making it even more difficult to compare it to the expected sharpness based on past experiences. Micro lettering's function is not readily apparent and remains largely unfamiliar. The feature lacks standardization and current designs fail to effectively communicate its function. Moreover, examining it can be somewhat inconvenient, requiring careful attention and sharp eyesight.

- IR-OVD - Iridescent optically variable devices (OVDs) come in either diffractive or interference types. The diffractive type is now known as diffractive optically variable image device (DOVID), while the interference type is commonly called interference security image structure (ISIS). OVDs are innovative advancements that are being used more frequently as security features on banknotes and other important documents. Various security features include holograms from companies like American Bank Note Holographics and De la Rue Holographics, kinograms from Landis & Gyr in Switzerland, exelgrams from CSIRO in Australia, dot-matrix devices from Applied Holographics in the UK, and movigrams from Hologram Industries in France. Other examples are thin film features on Canadian bank notes and the British Columbia driver's license by Identicard in Canada, as well as optically variable ink like OVI from SICPA in Switzerland.
- Optically Variable Ink - OVI is an iridescent printing ink based on an interference pigment. OVI printing changes colour with angle of observation. It is becoming more common as a security feature on bank notes, but its future as a standard is still uncertain.

1. How simple is it for the examiner to identify and comprehend the function of the device?

- The OVI's first line inspection function involves confirming or refuting the document by examining a particular color change based on the observation angle. In certain situations, the unusual color alteration can be quite noticeable and striking: the OVI print needs to encompass a significant area, be prominent in the design, and the color shift must be substantial. Transitioning from warm to cool colors, like shifting from gold to green or from one color to its complementary color, such as green to magenta, is highly preferred. Given these circumstances, the optically variable effect typically functions as a form of external knowledge, making it easy to understand the purpose of the OVI feature.

Despite the conditions mentioned earlier, there are instances where OVI is used in less ideal situations, such as when color changes are too subtle or the optically variable effect is almost hidden by background printing. An alteration from green to black might appear subtle and could be mistaken for a green metallic ink that doesn't change color. For instance, using a blue background for a green-to-blue shift can help conceal the iridescent effect and can be effectively replicated with a green pearl lustre ink. Given these conditions, the purpose of OVI may continue to be unclear and its utilization ineffective.

2.How clear is it for the examiner to determine the necessary actions?

- Seek out a unique color shift based on the viewing angle. Handling the document typically leads to a change in the observation angle. If the OVI element is well designed, the iridescent effect becomes quite apparent.

3.How simple is it for the examiner to perform the actions?

- Observing the effect is as simple as looking at the document in reflected light and tilting it while handling it. Thus, the behavior does not appear to be linked to any major psychological barriers.

4.How visible are the results to the examiner?

- When the OVI printing is well executed, the shifting interference colors immediately catch the eye and are clearly visible.

5.How simple is it for the examiner to compare the observed results with the expected results and make accurate conclusions?

- When OVI printing is properly executed, its color transformation is distinct and clear, leaving no room for confusion about what should be visible. OVI creates a clear optical effect that enables quick and straightforward inspection. The purpose is clear and examining it doesn't bring up any mental barriers.

- Post-printing iridescent OVDs - After the printing process, iridescent OVDs are applied to the document as either pressure-sensitive or hot-stamped DOVIDs and ISISs. Given the wide range of optical effects of OVDs, it is only possible to discuss their ergonomic aspects in a general manner, assuming that ergonomic designs are fully achieved. Considering various current OVD-designs, it seems that the latter assumption is not always justified.

1.How simple is it for the examiner to identify and comprehend the function of the device?

- Understanding the optical effects of OVDs may seem straightforward and clear. As a result, OVDs have the potential to convey necessary information in a way that can be easily understood, even without prior knowledge.

2.How clear is it for the examiner to determine the necessary actions?

- As the optical effects reveal themselves when observing OVDs from various angles, the necessary actions are almost instinctively carried out through standard document handling. As a result, the necessary tilt actions may be more or less obvious.

3.How simple is it for the examiner to perform the tasks?

- The impact can be easily seen in reflected light during regular document handling. The behavior is not linked to feelings of embarrassment. It's common to tilt a document while handling it, almost instinctively.

4.How visible are the results to the examiner?

- The alterations in image and color are eye-catching and readily noticeable.

5.How straightforward is it for the examiner to compare the observed results with the expected results and make accurate conclusions? The variations in color and image on OVDs are distinct and clear, ensuring there is no room for confusion regarding what is being viewed. The optical effects of OVDs enable convenient and

inconspicuous inspection. You can easily see their function by simply tilting the document, which is possible during regular handling.

## Conclusion

The ergonomic method in this investigation follows industrial design guidelines. This method can be applied to any first-line features and second-line features that necessitate human inspection. The views on security features may not be adopted by all readers. Therefore, the reader must correct, enhance, and complement the foregoing. However, this author believes the five fundamental questions about security device operation and the following tips are helpful. It's evident that many of the security features presented don't meet this article's first-line examination standards. This does not necessarily imply these features are inferior; they may be poorly implemented or require special handling. The difficult need for a security feature is to make its function plain. Standardization, preferably international, is necessary because this vital information is not always available.

The pronounced and distinctly defined optical effects of OVDs confer upon them this potential. The effects are readily caused by conventional document processing, therefore their function is obvious. Since optical effects are well-defined and self-evident, observed outcomes can be compared to expected results. Drivers possess the requisite skills to operate a motor vehicle. Fundamental functions are standardized on a global scale. Although the majority of individuals handle banknotes on a daily basis, a limited number possess knowledge of the fundamental security features associated with domestic currency, let alone those pertaining to foreign currency. This lack of awareness can be attributed to (1) inadequate ergonomic design and (2) insufficient standardization, even among denominations within a single country. Why have currency with difficult-to-handle or unmemorable functions if nobody desires them? Ultimately, central banks do not provide compensation to individuals for counterfeit currency they may acquire, even though the majority of individuals are unable to distinguish between genuine and counterfeit notes. Currency ought to possess universally recognized functions that enable individuals across the globe to efficiently and dependably ascertain its status.

